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The relationships between two personality measures (dissociation and cognitive failures) and different measures of interference from secondary tasks for working memory are investigated. Although the personality and cognitive measures were correlated with one another, canonical and bivariate correlations revealed no systematic relationships between the personality measures and the working memory measures. The upper bounds of the confidence intervals showed that, at most, only 10% of the variance was shared. We discuss the implications for theories of dissociation and cognitive functioning.

The relationship between personality measures and memory performance has gained importance in recent years, prompted by a growing interest in the areas of dissociation, cognitive failure, and memory because of their association with the phenomenon of recovered memories (Freyd, 1996; Loftus, 1997; McNally, 2003; Putman, 1984; Wessel & Wright, 2004). Although much of the interest has been on long-term memory, especially its malleability (Read & Winograd, 1998; Wright & Livingston-Raper, 2002), our interest is in whether these personality measures are associated with tasks involved with the different systems of working memory. We review the working memory model and the concepts of dissociation and cognitive failures and then look at previous research that has examined the relationships between them.

Baddeley's (1986) working memory model is one of the most influential and successful models of memory. The working memory model has three components: the central executive and two slave systems, called the phonological loop and the visuospatial sketchpad.[1] The central executive is an attentional and coordinating system that uses the representations stored in the two slave systems for complex cognitive tasks such as reasoning and comprehension. Of the two slave systems, more is known about the phonological loop. It is assumed to consist of two parts: a phonological store and an articulatory loop. The phonological store holds acoustic and speech-based material in a short-term store. The material can be held only for about 2 s unless it is maintained by rehearsal in the articulatory loop. The visuospatial sketchpad maintains visual and spatial information,

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although the exact mechanisms are not yet known (Andrade, Kemps, Werniers, May, & Szmalec, 2002).

This model is well supported by evidence from a variety of fields, but its development has been most influenced by laboratory studies into the effects of interference on short-term memory performance (Murray, 1968; Della Sala, Gray, Baddeley, Allamano, & Wilson, 1999). With interference techniques, participants are required to perform a task while performing another task designed to use one of the components of working memory. This concurrent task usually is called a secondary task.

In everyday life people encounter information from multiple sources. It is important to understand how people cope with this. Dissociation can occur when there are difficulties integrating information from multiple sources, including experiences, memories, emotions, bodily sensations, and actions. Most people have experienced a dissociative state, such as daydreaming while driving home and being unaware of some part of a car journey (Ross, 1997). Individual differences in dissociative tendencies often are measured with the Dissociative Experience Scale (DES), developed by Bernstein and Putman (1986; Carlson & Putnam, 1993). At extreme levels dissociation is associated with the diagnosis of dissociative identity disorder (DID), formerly called multiple personality disorder (Carlson et al., 1993). Since it has been studied as a clinical disorder, dissociation has been linked with memory dysfunction. Most of this research has been on autobiographical recall and information transfer across amnesic states (Dorahy, 2001), on the malleability of memory (Wright & Livingston-Raper, 2002), and on the relationship between trauma and dissociation (Eriksson & Lundin, 1996). There has been less research into associations of dissociation with working memory.

There is also much interest in cognitive failures. Cognitive failures are everyday lapses in attention, memory, and perception. Individual differences in cognitive failures often are measured with the Cognitive Failure Questionnaire (CFQ, Broadbent, Cooper, FitzGerald, & Parkes, 1982). The CFQ is a self-assessment scale that measures a person's likelihood of committing an error in the completion of an everyday task. Like dissociation, cognitive failures have been associated with memory dysfunctions (Merckelbach, Muris, Nijman, & De Jong, 1996). Harnishfeger (1995) suggested that problems with inhibitory processes are in part responsible for many cognitive failures because too much information is active in working memory. Because dissociation is related to difficulties dealing with too much information, it is predicted that dissociation and cognitive failures should be positively associated. This is supported by Merckelbach, Muris, and Rassin's (1999) finding that the DES and CFQ are correlated.

There is evidence that DID sufferers may show working memory deficits.

Rossini, Schwartz, and Braun (1996) found that 26% of patients with some form of dissociative disorder had deficits on the scales of the Wechsler Adult Intelligence Scale–Revised (WAIS-R) believed to tap short-term memory and attentional processes. There is also evidence that dissociation is associated with working memory impairment in nonclinical populations.

Freyd and colleagues conducted several important studies related to attention, memory, and dissociation. Freyd, Martorello, Alvarado, Hayes, and Christmas (1998) found that people with high DES scores had greater Stroop interference than those with low DES scores. This suggests that people who dissociate frequently are at a disadvantage on tasks that require selective attention. However, in another study DePrince and Freyd (1999) showed that highly dissociative people showed less interference when a dual-task Stroop procedure was used. More recently, DePrince and Freyd (2004) found that the type of word being recalled also related to memory performance. In particular, they found that people who dissociate often have particular difficulty remembering trauma-related words when attention is divided. However, the opposite pattern emerged for neutral words. Clearly more research is necessary to disentangle the complex relationship between dissociation and memory.

Because of the relationship between cognitive failures and dissociation, it is important to see whether scores on the CFQ are related to impairment from secondary tasks. Some related research exists. For example, a high score on the CFQ appears to be negatively correlated with efficiently dealing with two things at once (Harris & Wilkins, 1982) but positively related to selective attention tasks (Vom Hofe, Mainemarre, & Vannier, 1998). Other studies have not found any relationship (Broadbent et al., 1982).

In summary, there are good reasons to suspect that people who dissociate frequently also experience more cognitive failures than other people. Furthermore, although there is much research on how dissociation relates to long-term memory failure, there is less on short-term memory and attention failure. Similarly, the research examining the relationship between cognitive failures and working memory does not provide clear results. Therefore, research examining these relationships is needed. This study aims to replicate the previous findings of Merckelbach et al. (1999) that DES and CFQ scores correlate and then to examine how these measures relate to participants' ability to perform secondary tasks that tap different components of working memory: verbal, visual, and spatial. The focus is on the slave systems of working memory rather than the central executive because it is more difficult to isolate the central executive in laboratory tasks (Baddeley, 2001).

EXPERIMENT

METHOD

Eighty undergraduate students from the University of Sussex volunteered for this study. They performed a series of working memory tasks, with and without a secondary task, and then completed the personality questionnaires. We decided to have 80 participants based on a power analysis for a medium (Cohen, 1988) effect size. This yields a power of .78 for $\alpha = .05$.

Three working memory tests were used: the Digit Span Test, Visual Patterns Test (VPT), and the Corsi Block Test. For the Digit Span Test (Baddeley, 1986), participants are shown lists of randomly generated numbers and have to repeat these numbers. The secondary task used with this test was articulatory suppression. Participants had to repeat *the* out loud during the task (Murray, 1968). The VPT (Della Sala, Gray, Baddeley, & Wilson, 1997) consists of sets of checkerboard patterns designed to be difficult to code verbally, which participants need to remember. The secondary interference task used was showing 12 prints of abstract paintings chosen to be difficult to code verbally (Logie, 1986). The Corsi Block Test (as cited in Della Sala et al., 1999) was used as the primary spatial task. It consists of nine wooden blocks fixed to a flat board. The experimenter taps out a sequence of them, and the participant has to mimic this sequence. The secondary task used was devised by Smyth, Pearson, and Pendleton (1988). Participants had to continuously tap four flat plastic boards in a clockwise direction.

Two personality questionnaires were used. Participants' levels of dissociation were measured using the DES Comparison (DES C), a slight adaptation of the original DES that Wright and Loftus (1999) found to produce a less skewed distribution with their student samples than the original. The CFQ (Broadbent et al., 1982) was administered to assess participants' everyday cognitive lapses.

Participants were tested individually in a room with the experimenter (J.E.O.). The experiment took place in two phases for the visual, spatial, and phonological tests. First, participants performed these tests without a secondary task, and then they performed them with a secondary task. The difference in performance was taken as a measure of interference from the secondary task. The order of tests was VPT, Digit Span Test, and Corsi Block Test. Order was not counterbalanced (in total there would have been 720 possible orders) because it was important to make sure that everybody's difference score was based on the same order. This does mean that there may be practice effects where scores with the secondary task could be better than would be expected if they had not completed the task without the secondary task earlier. This is discussed with respect to the statistical models used.

To begin each test, the participant was presented with two items (e.g., two numbers, two squares filled in, or two blocks tapped), which the participant had to repeat. Each participant had three trials at this level. If they successfully completed this level, the difficulty was increased by one item. This continued until the participant incorrectly reproduced a sequence. The participant's score was recorded as the level at which he or she last correctly reproduced three sequences. Partial credit was given if the participant reproduced one or two of the three trials.

When participants finished these tasks, the two personality questionnaires were completed.

RESULTS

Before discussing the relationships between the personality measures and the working memory measures, we report univariate descriptive statistics. The personality variables are dissociation measured by the DES C (Wright & Loftus, 1999) and cognitive failures measured by the CFQ (Broadbent et al., 1982). Figure 1 shows histograms of these measures; both appear roughly normally distributed. Kolmogorov–Smirnov tests confirm this finding, $z = .70$, $p = .72$ for DES C, $z = .74$, $p = .65$ for CFQ. The distributions are not significantly skewed, skewness = –.27 ($SE = .27$) for DES C, skewness = –.07 ($SE = .27$) for CFQ.

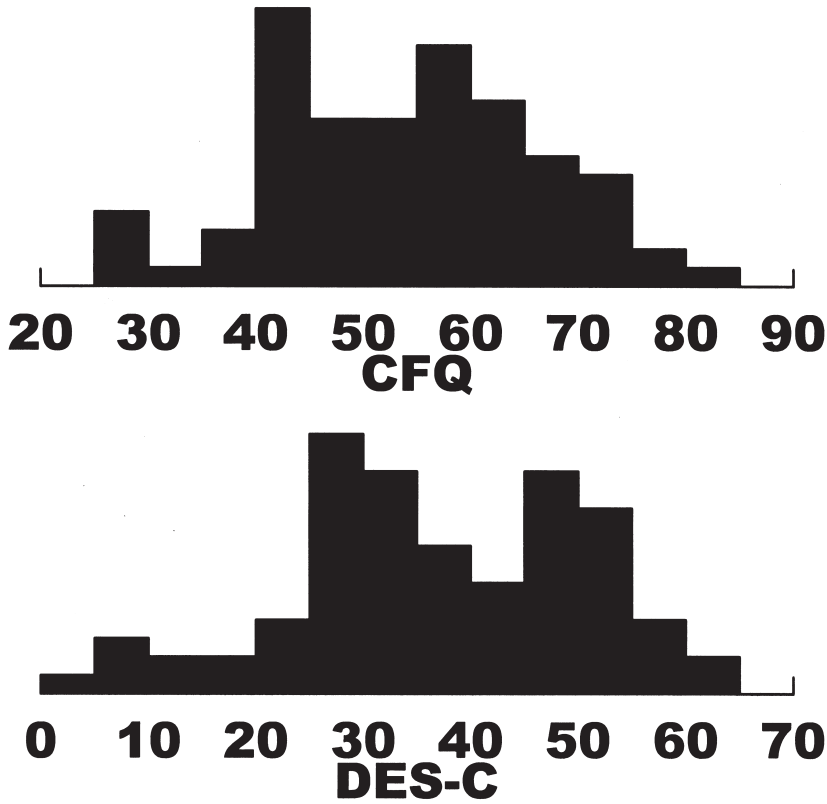

Figure 1. Histograms of Cognitive Failure Questionnaire and DES C for the sample

Next we looked at the bivariate relationships within the personality measures and within the working memory variables. Replicating Merckelbach et al. (1999), we found a large positive correlation between dissociation and cognitive failures, $r = .61$, with a 95% confidence interval of .45–.74; see Figure 2.

The working memory variables were scores on visuospatial, digit span, and Corsi tests, both with and without the secondary task. There are two important issues. The first is to make sure that people tend to perform worse during the secondary task. For each of the three measures the secondary tasks lowered performance: visuospatial, standardized difference in means $d = 0.69$ standard deviations, $t(79) = 6.14$, $p < .001$; digit, $d = 1.24$, $t(79) = 11.06$, $p < .001$; and Corsi, $d = 1.44$, $t(79) = 12.93$, $p < .001$.

Researchers tend to use two main approaches when examining the differences between scores on two tests and a third variable. The most intuitive (and most used) way is to subtract the scores and run a correlation between this difference and the third variable (or t test if the third

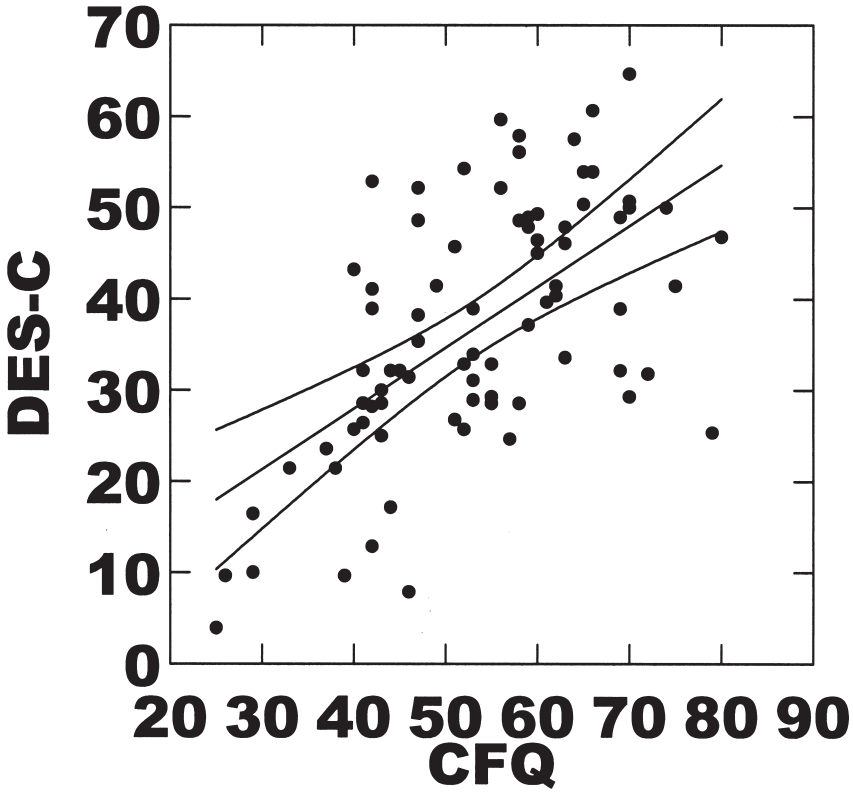

Figure 2. Association between DES C and Cognitive Failure Questionnaire

variable is binary). We begin by reporting these statistics. In the second approach, participants' scores with the secondary task are regressed on the scores without the secondary task. The residual is then correlated with the third variable. This is the analysis of covariance (ANCOVA) approach. Because of learning effects, it is expected that the score with the secondary task could be higher than it would otherwise be. This means that there are advantages to this approach in this circumstance (Wainer, 1991), but following Wright (2003) we report both methods. Other methods were also used and produced similar conclusions.

A canonical correlation was conducted to see whether a linear combination of DES C and CFQ was associated with a linear combination of the differences between working memory measures with and without the secondary task. This is an omnibus test, like the F in an ANOVA and the multiple R in multiple regression; finding a significant statistic does not identify where the association is. The maximum correlation that can be created from linear combinations of these variables is $r = .25$. This is not statistically significant, $\chi^2(6) = 5.36$, $p = .50$. In an exploratory manner, the bivariate comparisons between the personality and the working memory measures were also examined. Table 1 shows the correlations and their 95% confidence intervals.

Although none of the bivariate correlations are significant at $\alpha = .05$, the observed effects are larger for CFQ than for DES C. Again, in an exploratory manner, the correlations between CFQ and the working memory measures were calculated partialling out the DES C score. This removes the shared variance of CFQ and DES C, which lowers the total amount of variation. Now the correlation between CFQ and VPT is $r = .24$, which just reaches statistical significance ($p = .04$). Given the number of statistical tests conducted, we do not want to overinterpret this result. Other statistical analyses were also conducted but lead to the same interpretation: DES C and CFQ have at most low associations with the impact of secondary tasks on the components of working memory. Thus, Table 1 summarizes our results well.

Table 1. Correlations between the cognitive and personality measures

	Cognitive measures		
	Visual Patterns Test	Digit Span Test	Corsi Block Test
Dissociative Experiences Scale Comparison	–.01 (–.23, .22)	.00 (–.23, .22)	.09 (–.13, .31)
Cognitive Failure Questionnaire	.18 (–.04, .39)	.04 (–.18, .27)	.11 (–.11, .33)

Note. 95% confidence intervals are in parentheses.

The ANCOVA approach was also used. Rather than using the differences, the residuals of the model, $score2_i = \beta0 + \beta1\ score1_i + e_i$, were correlated with personality measures. The largest correlation that could be created from linear combinations of the three residual variables and the two personality variables was .23, $p = .54$. Bivariate correlations were also small, maximum $r = .17$, and nonsignificant, all ps $> .10$. In an exploratory fashion the partial correlations were again estimated. The only way to reach the standard significance level was partialling out DES scores between CFQ and the residuals for the VPT, $r = .23$, $p = .04$. Thus, the results are the same as the analysis on the differences.

DISCUSSION

Understanding the relationship between personality measures, such as dissociation and cognitive failures, and people's ability to perform tasks while engaged in secondary tasks is important. We found that these personality measures were not systematically associated with the impairment caused by engaging in secondary tasks for three different components of working memory. Previous studies found that dissociation and cognitive failures were related to working memory tasks, but in different ways. Given that these two personality measures were found to be positively correlated, this suggested that there is a complex interaction between these measures or that the relationships between them and the working memory measures are not as strong as previously thought.

Our study had 80 participants. An a priori power analysis showed that this was a good sample size to detect what Cohen (1988) called a medium-sized correlation of $r = .30$. There were no statistically significant bivariate correlations, and the omnibus canonical correlation was also nonsignificant. The upper bounds of the correlations' confidence intervals allow us to be confident that association between the personality measures (dissociation and cognitive failure) and the interference measures are at most just medium sized. Because the confidence intervals overlap with zero, we cannot even be confident in the direction of the association. Although it is not sensible to accept a null hypothesis, the data do allow us to conclude that any effects are not large.

Given that past research has suggested that there could be some associations, it is worth discussing why we may have found no effects but other published research has. One explanation is that the effects are small, but researchers tend to submit only papers with "significant" findings (the file drawer problem) and that reviewers sometimes view null effects negatively (the publication bias). When the power of a study is low, research with null effects should not be submitted to journals, and if it is then the article should be rejected. Here, however, the power is at the convention-

ally accepted levels. The second reason is that there are several important associative processes and that in the current study some of these processes are acting in opposition to each other. Dissociation and cognitive failures are complex personality constructs, and their effects may cancel each other out. Because the only statistically significant association was a partial correlation, further research should be designed to disentangle possible effects. Both of these reasons produce the same conclusion: Our results show that there are no simple relationships between the measures of dissociation and cognitive failures and inference from secondary working memory tasks.

Notes

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1. Baddeley's (2001) model now includes an episodic buffer, which is valuable for linking long-term memory and the traditional working memory systems. The current study focuses on short-term memory and therefore on the original components, where secondary tasks are better developed.

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