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Elevated cognitive failures in trait anxiety

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ABSTRACT

Previous research indicates that individuals with high levels of trait anxiety have poor attentional control as gauged by the Attentional Control Scale (ACS). However, the Cognitive Failures Questionnaire (CFQ) is a measure of attentional control that has key advantages over the ACS, including predicting important real-world outcomes such as car crash risk. The present study assessed the relationships between trait anxiety, cognitive failures as gauged by the CFQ, and the Focusing and Shifting factors from the ACS in a large sample (N = 532) of adult participants. It was found that higher levels of trait anxiety were associated with increased cognitive failures, and CFQ scores explained unique variance in trait anxiety beyond that explained by either Focusing or Shifting. This means that trait anxious individuals experience problems with attentional control that manifest in important real-world domains such as driving. We discuss reasons why future research should employ the CFQ when investigating experiences of attentional control in relation to trait anxiety. Further, individual differences in the use of reappraisal as an emotion regulation strategy did not account for the relationship between attentional control and trait anxiety. This informs theoretical models that seek to explain why these variables are related.

1. Introduction

Attentional control refers to an individual's capacity to effectively and flexibly regulate their attention to focus on goal-relevant information without succumbing to distraction (Burgoyne et al., 2023). Poorer attentional control is associated with higher levels of trait anxiety. This relationship is evident both when attentional control is measured via specific tasks in the laboratory (Shi et al., 2019), and when attentional control is measured via participants' reports about their experiences with their attentional control in a wide range of real-world situations in everyday life (Derryberry & Reed, 2002; Richey et al., 2012; Takil & Sari, 2021). Here, the focus was on the latter. Previous research has used the ACS to measure real-world experiences of attentional control, and shown that individuals with higher levels of trait anxiety score lower on the Attentional Control Scale (ACS) indicating that they experience more difficulty with attentional control (Derryberry & Reed, 2002; Richey et al., 2012; Takil & Sari, 2021).

This work with the ACS has provided important insight into subjective experiences of attentional control and how they relate to trait anxiety. There is some evidence that the ACS can predict objective attentional control performance (Judah et al., 2014). However, more recent work has questioned the validity of the ACS. For example, it has been noted that ACS scores may be more contaminated by error variance due to differences in metacognitive insight, because they require participants to make abstract assessment about their global ability (e.g., to switch tasks), rather than focusing on more concrete outcomes of attentional control in specific circumstances (Thomson & Goodhew, 2021). Further, the relationship between ACS scores and objective attentional control function has been questioned by a recent meta-analysis (Clarke & Todd, 2021). In a similar vein, one recent study assessed attentional control predictors of low prevalence visual search performance. This is an important attentional control task implicated in diagnostic medical imaging and airport baggage screening (Wolfe et al., 2005). This study found no relationship between ACS scores and performance (Thomson & Goodhew, 2021). In contrast, another measure of everyday experiences of attentional control was associated performance: the Cognitive Failures Questionnaire (CFQ).

The CFQ has a similar goal to the ACS, in that it is conceptualised as a trait-like variable that reflects the control of executive attention in everyday life (Eysenck et al., 2007; Friedman & Miyake, 2004). Unlike the ACS, the CFQ asks respondents to indicate the frequency of more concrete outcomes of attentional control (and failures thereof) in everyday life, such as forgetting appointments, bumping into people, failing to notice signposts on the road, and forgetting why you went from

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one part of the house to another. Consistent with this, the CFQ has a more impressive array of evidence for its validity. CFQ scores correlate with objective performance on a range of attentional control tasks (Forster & Lavie, 2007; Friedman & Miyake, 2004; Goodhew & Edwards, 2023; Robertson et al., 1997). CFQ scores also correlate with individual differences in brain structure in areas associated with attentional control in samples that include premenopausal women following chemotherapy for breast cancer (Deprez et al., 2011). Individual differences in CFQ scores translate into important real-world outcomes, such as association with an individual's risk of car crash and work accident (Wallace & Vodanovich, 2003). However, despite the clear importance of CFQ scores, in the trait anxiety literature in which attentional control is considered, the CFQ has been overlooked. Here we sought to rectify this, to provide deeper insight into the everyday attentional control experiences of those with different levels of trait anxiety. Given the stronger evidence for the CFQ's validity as an assessment of attentional control, we tested whether CFQ scores were related to trait anxiety, and whether they explained variance in trait anxiety above and beyond that already explained by ACS scores.

Furthermore, another way that attentional control (or lack thereof) can manifest is via the emotion regulation strategies that individuals employ in everyday life. Individual differences in both trait anxiety and attentional control are associated with an individual's tendency to employ cognitive *reappraisal* as an emotion-regulation strategy in everyday life. Reappraisal involves changing the way one thinks about (or appraises) a situation or event to increase or decrease one's emotional experience (Gross & John, 2003). Individuals who spontaneously use reappraisal frequently in everyday life enjoy a host of social and emotional benefits, including increased positive affect, decreased negative affect, higher self-esteem, and greater social connectedness (English et al., 2012; Gross & John, 2003; McRae & Gross, 2020). In particular, diminished use of reappraisal is associated with mood disorders including anxiety and depression (Aldao et al., 2010), and individuals with higher CFQ scores use reappraisal less often as an emotion regulation strategy (Robins et al., 2012). Here we therefore tested whether reappraisal accounts for the shared variance between attentional control and trait anxiety.

To summarise, here we measured trait anxiety, attentional control as gauged by both the CFQ and the ACS, and the tendency to use reappraisal as an emotion-regulation strategy, in a large sample of community participants. This allowed us to test two outstanding questions: (1) Are CFQ scores related to trait anxiety, above and beyond the variance in trait anxiety already explained by ACS scores? (2) Does reappraisal account for the relationship between attentional control and trait anxiety?

2. Method

2.1. Participants

A power analysis conducted in G*Power (Faul et al., 2007) indicated that to have 80 % power to detect a small effect in a two-predictor linear multiple regression (alpha = 0.05, two-tailed) required N = 485. We added 10 % to account for potential exclusions, and therefore sought to recruit N = 534. We opted for a small effect size in these calculations as a conservative approach to ensure that we had sufficient power to detect even small effects, and would therefore have ample power to detect larger effects.

A total of 535 participants were recruited via Prolific. All participants provided informed consent prior to participation. We chose Prolific as the recruitment platform due to evidence for superior data quality relative to its competitors (Peer et al., 2022). Participants were required to be in a specific location (United Kingdom, UK), so that we could provide details mental health help services available in their region. Participants were required to be fluent in English and were paid £1.5 for approximately 10 min of their time.

Following the exclusion of three participants due to failing attention and data validity checks (described in full below), the final sample for analysis was N = 532. The mean age of this sample was 38.22 years (SD = 13.46), 283 identified as male, 239 female, 3 non-binary, 3 other, and 4 selected prefer not to say, 453 were born in the United Kingdom, 471 indicated that English was their native language, and 460 were right-handed, 56 left-handed, and 16 ambidextrous.

2.2. Materials

The State and Trait Anxiety Inventory (STAI) (Copyright © 1968, 1977 by Charles D. Spielberger) (Spielberger et al., 1983) was used to measure participants' Trait Anxiety. State anxiety was also measured as a covariate. For Trait Anxiety, respondents select from four possible responses (1 = Almost never, 2 = Sometimes, 3 = Often, 4 = Almost Always) to indicate the extent to which they agree with 20 statements about how they feel in general (e.g., *I am a steady person*), of which 9 are reverse-scored. For State Anxiety, respondents select from four possible responses (1 = Not at all, 2 = Somewhat, 3 = Moderately so, 4 = Very much so) to indicate the extent to which they agree with 20 statements regarding how they feel in the present moment (e.g., *I feel at ease*), 10 of which are reverse-scored. For both, possible scores range from 20 to 80 and higher scores indicate greater levels of anxiety.

Judah et al. (2014) conducted a factor analysis that identified a two-factor structure of the original Attentional Control Scale (ACS) (Derryberry & Reed, 2002). One of these factors reflects *Focusing*, which is the ability to ignore distraction. The other factor gauges *Shifting*, which is about the ease of switching between different tasks (Judah et al., 2014). These two different factors have dissociable relationships with performance on attentional control tasks (e.g., Focusing but not Shifting associated with antisaccade performance and Shifting but not Focusing associated with switch trial performance; Judah et al., 2014). Similarly, Shifting has been found to be positively correlated with Cognitive Empathy while Focusing negatively correlated with Affective Empathy (Goodhew & Edwards, 2021). These differential relationships highlight the danger in treating ACS as unitary (e.g., different direction relationships with other variables could cancel one another out to misleading look like no relationship). That is, they indicate that Focusing and Shifting ought to be treated as distinct factors, which is what we did here.

The Focusing factor consists of seven items (e.g., *It's very hard for me to concentrate on a difficult task when there are noises around*), which are all reverse scored, while the Shifting factor consists of five items (e.g., *I can quickly switch from one task to another*), none of which are reverse scored. For all items, participants select one of four response options (1 = Almost Never, 2 = Sometimes, 3 = Often, 4 = Always), such that higher scores indicate greater attentional control for both factors. Possible Focusing scores range between 7 and 28, and possible Switching scores range between 5 and 20.

The Cognitive Failures Questionnaire (CFQ) (Broadbent et al., 1982) consists of 25 items about commonplace mistakes and cognitive slips (e.g., *Do you forget why you went from one part of the house to another?*). Participants select one of five response options (0 = Never, 1 = Very Rarely, 2 = Occasionally, 3 = Quite Often, 4 = Very Often) to indicate the extent to which they have experienced these cognitive failures in the past six months. Possible CFQ scores range from 0 to 100, where higher scores indicate greater cognitive failures (and so lower scores indicate greater attentional control). While various attempts to identify distinct factors underscoring the CFQ have been made, these attempts have often yielded factor structures that are unstable (Bridger et al., 2013), or have not been shown to produce consistent dissociable relationships with performance or explain variance above and beyond when the CFQ is treated as unitary (Goodhew & Edwards, 2023). Therefore, we treated the CFQ as unitary.

The Emotion Regulation Questionnaire (ERQ) was used to gauge individual differences in emotion regulation tendencies in everyday life (Gross & John, 2003). Specifically, the ERQ consists of two factors:

Reappraisal and Suppression. Here Reappraisal was considered as a potential explanatory variable for any shared variance between trait anxiety and attentional control, and Suppression was also collated for descriptive purposes since it is part of the ERQ. The Reappraisal scale consists of six items (e.g., *When I want to feel less negative emotion, I change the way I'm thinking about the situation*) while Suppression consists of four items (e.g., *I keep my emotions to myself*). There are seven response options, ranging from 1 = Strongly disagree to 7 = Strongly agree, such that higher scores indicate a greater tendency to engage in that form of emotion regulation. Possible Reappraisal scores range from 6 to 42, and possible Suppression scores range from 4 to 28.

Participants also answered demographic questions, and five data-validity check questions. These consisted of two attention check items where participants were instructed to select a particular response, and three questions where one there was one typical and one unusual response (i.e., Yes/No responses to: (1) I am personal friends with the King of England, (2) I have been to the moon, and (3) I have used a computer before).

2.3. Procedure

The study was administered via Qualtrics. Participants were first presented with an Information Sheet, and a question asking whether they consented to participate. After responding Yes, participants received the five blocks in an order randomised for each participant (STAI-Trait, STAI-State, ACS, CFQ, ERQ). Within each block, participants received the instructions for that scale and indicated Yes/No regarding whether they had read and understood these instructions, and then the items were presented in the same order. The two attention-check items appeared amongst the questionnaire items (i.e., one at the end of the CFQ, one at the end of the ACS). Participants completed the demographic and the three typical-response data-validity questions last, before receiving onscreen debriefing information. For all items, missing responses triggered a request to respond that could be dismissed to continue, except for consent for which a response was mandated.

3. Results

3.1. Raw data, exclusions, and missing data

N = 535 gave their consent and completed the study via Prolific. De-identified raw data are available here: https://osf.io/297h4. Data analysis was performed in JASP (Version 0.14.1, JASP Team, 2020). All statistical tests were two-tailed. One participant's data were excluded due to failing to respond to an attention check as instructed, and two were excluded due to responding "No" to the item about having used a computer before. While it is not inconceivable that this was true (e.g., used a tablet or phone to access the internet), to be confident in the validity of the data in the final sample, these two were excluded. All participants indicated "Yes" to having read and understood all the scale instructions. The final sample was N = 532.

One participant had a missing response to an ACS Focusing item, and the mode of their response values to the other six Focusing items (i.e., that participant's most common response) was entered as the missing value. One participant missed responses to two CFQ items, and the mode of their response values to the other 23 CFQ responses was entered for both missing values. Following this, there was no missing data.

3.2. Descriptive statistics

The descriptive statistics for each of the scales are shown in Table 1. This shows that all measures had adequate reliability, indeed, many had excellent reliability.

Table 1
Descriptive statistics for the scale variables.

Variable	Mean (SD)	Standardized SD	McDonald's ω [95 % confidence interval]
Trait anxiety	48.74 (13.03)	21.72 %	0.95 [0.95, 0.96]
State anxiety	40.93 (13.82)	23.03 %	0.96 [0.96, 0.97]
Focusing	18.65 (4.39)	20.90 %	0.86 [0.84, 0.88]
Shifting	12.20 (2.88)	19.20 %	0.78 [0.75, 0.81]
Cognitive failures	41.15 (16.17)	16.17 %	0.93 [0.92, 0.94]
Reappraisal	28.27 (6.11)	16.97 %	0.87 [0.86, 0.89]
Suppression	16.57 (4.94)	20.58 %	0.80 [0.78, 0.83]

Note. Trait and State Anxiety derived from the State Trait Anxiety Inventory (STAI), Focusing and Shifting from the Attentional Control Scale (ACS), Cognitive Failures from the Cognitive Failures Questionnaire (CFQ), and Reappraisal and Suppression from the Emotion Regulation Questionnaire (ERQ).
Note. Standardized SD = (SD / scale-range) * 100, a percentage measure of variance spread that is comparable across scales with different ranges (Goodhew et al., 2020).
Note. Suppression was not used in any of the inferential analyses performed here, it is provided here merely for illustrating the descriptive statistics in the sample.

3.3. Bivariate correlations

The bivariate correlations between all the variables of interest are provided in Table 2.

Table 2 shows that Trait Anxiety had strong negative associations with Focusing and Shifting. This contrasts with previous research with smaller samples (e.g., N = 48 in Judah et al., 2014) that have suggested that it is Focusing and not Shifting is associated with Trait Anxiety. The present study used a very large sample size, and so it is possible that the previous studies did not have the power to detect the relationships that were observed here. Further, Trait Anxiety was strongly positively associated with Cognitive Failures. This is to our knowledge the first study to observe an association between these variables.

Consistent with previous research, Reappraisal was moderately negatively associated with Trait Anxiety (Aldao et al., 2010; McRae & Gross, 2020), and Reappraisal had small to moderate associations with all three indices of attentional control (Robins et al., 2012). Also consistent with previous research, Focusing and Shifting were moderately positively correlated with each other, and each was negatively correlated with Cognitive Failures (strong correlation for Focusing, moderate for Shifting) (Judah et al., 2014).

3.4. Do CFQ scores explain variance in trait anxiety beyond ACS scores?

To assess this, a linear multiple regression was performed where Trait Anxiety was the criterion and Focusing, Shifting, and Cognitive Failures were entered simultaneously as predictors. One case with an extreme standardized residual (i.e., greater than the absolute value of 3) was removed. The overall model was significant, $F(3, 527) = 121.75$, $p < .001$, $R^2_{adj} = 0.41$. Table 3 shows the regression coefficients.

Table 3 shows that Cognitive Failures explained unique variance in Trait Anxiety that was not already accounted for by Focusing and Shifting. This relationship was not accounted for by differences in Age, Gender, or State Anxiety.

3.5. Does reappraisal account for the relationship between attentional control and trait anxiety?

To test this, another multiple regression (returning to full sample N = 532) was performed where the criterion was Trait Anxiety,

Table 2
Pearson's r correlations between variables of interest. [95% Confidence intervals of coefficients shown in square brackets]

Variable	TA	SA	F	S	CF	R	Age
SA	0.79***						
	[0.76, 0.82]						
F	−0.51***	−0.36***					
	[−0.57, −0.45]	[−0.43, −0.29]					
S	−0.46***	−0.34***	0.43***				
	[−0.52, −0.39]	[−0.41, −0.26]	[0.36, 0.50]				
CF	0.54***	0.42***	−0.60***	−0.32***			
	[0.48, 0.60]	[0.35, 0.49]	[−0.65, −0.55]	[−0.39, −0.24]			
R	−0.37***	−0.32***	0.15***	0.25***	−0.13**		
	[−0.44, −0.29]	[−0.39, −0.24]	[0.07, 0.23]	[0.17, 0.33]	[−0.22, −0.05]		
Age	−0.25***	−0.23***	0.26***	0.15***	−0.14**	0.09*	
	[−0.33, −0.17]	[−0.31, −0.15]	[0.18, 0.33]	[0.07, 0.23]	[−0.22, −0.05]	[0.01, 0.18]	
Gender	0.13**	0.07	−0.09*	0.01	0.24***	0.01	−0.09*
	[0.04, 0.21]	[−0.01, 0.16]	[−0.17, 0]	[−0.08, 0.09]	[0.16, 0.32]	[−0.07, 0.10]	[0, 0.17]

Note. SA = State Anxiety, TA = Trait Anxiety, F = Focusing, S = Shifting, CF = Cognitive Failures, and R = Reappraisal.
Note. Some non-normality was present in some variables (skew and kurtosis >3.29), however, non-parametric correlation coefficients (i.e., Spearman's rho) yielded very similar relationships – none changed direction, and none changed from significant to non-significant. In all cases, the Spearman's rho coefficient had the same first value after the decimal as their parametric counterpart when rounded to two decimal places (e.g., −0.51 and −0.53 for the correlation between Trait Anxiety and Focusing both begin with −0.5).
Note. For the Gender correlation, just the two most reported genders were included so that binary coding could be used to make it possible to enter as a regression predictor. These were male (N = 283) and female (N = 239), coded as 0 and 1 respectively.
Note. The demographic variables Age and Gender were included here to establish which variables of interest they were related to.
Note. No * means $p > .05$.
*** $p < .001$.
** $p < .01$.
* $p < .05$.

Table 3
Regression coefficients for measures of attentional control predicting trait anxiety.

Variable	Standardized (β)	Unstandardized (b)	Unstandardized 95 % CIs
Focusing	−0.19***	−0.57	−0.83, −0.32
Shifting	−0.26***	−1.19	−1.52, −0.86
Cognitive failures	0.35***	0.28	0.21, 0.34

Note. When State Anxiety was entered in the null in the model to control for it, all the above coefficients remained significant in the main model ($p < .001$). Next, Age and Gender were also added to the null the model, and the sample was restricted to those reporting one of the two most common genders. Again, all above coefficients remained significant ($p < .001$).
Note. Another way to conduct the regression would have been to enter Focusing and Shifting into the null model in the first step, and then assess the relationship between Cognitive Failures and Trait Anxiety. When this approach was taken, the model was significant ($p < .001$), and the relationship between Cognitive Failures and Trait Anxiety was identical to that shown in Table 3.
Note. For all regression models reported here, VIFs were <2.
Note. No * means $p > .05$.
*** $p < .001$.

Reappraisal was entered in the null model, and then the attentional control predictors (Focusing, Shifting, and Cognitive Failures) were entered simultaneously. One participant with an extreme residual value was removed. This revealed a significant model, $F(4, 526) = 114.40$, $p < .001$, $R^2_{adj} = 0.46$. Table 4 shows the regression coefficients.

Table 4 shows that all three indices of attentional control accounted for variance in Trait Anxiety above and beyond that explained by Reappraisal. This means that despite significant bivariate relationships between Reappraisal and Trait Anxiety, and between Reappraisal and each of the indices of attentional control, Reappraisal did not account for the shared variance between any of the attentional control measures and Trait Anxiety.

Table 4
Regression coefficients for measures of attentional control predicting trait anxiety when controlling for reappraisal.

Variable	Standardized (β)	Unstandardized (b)	Unstandardized 95 % CIs
Focusing	−0.19***	−0.56	−0.80, −0.31
Shifting	−0.21***	−0.94	−1.3, −0.62
Cognitive failures	0.34***	0.27	0.21, 0.33

Note. No * means $p > .05$.
*** $p < .001$.

4. Discussion

The present study showed that Cognitive Failures (i.e., CFQ scores) explained unique variance in trait anxiety above and beyond that explained by the Focusing and Shifting factors from the ACS, and that reappraisal did not account for the observed relationship between trait anxiety and any of the three attentional control indices (Cognitive Failures, Focusing, or Shifting). The implications of these findings are discussed below.

The present results indicate that individuals with higher levels of trait anxiety are more likely to experience cognitive failures in everyday life, some which might be merely inconvenient (e.g., forgetting an appointment, bumping into people), but others which can have more dire consequences (e.g., failing to notice signposts on the road). Given that CFQ scores are associated with crash risk (Wallace & Vodanovich, 2003), one practical implication is that individuals prone to anxiety may benefit from interventions that have been shown to reduce crash risk, such as hazard perception training (Horswill, 2016).

There is still more work to be done in elucidating the mechanisms underlying the relationship between attentional control and trait anxiety. We recommend that future research investigating the relationship between real-world experiences of attentional control and trait anxiety use the CFQ. As discussed in the Introduction, the CFQ boasts key advantages in its format and predictive validity that we believe make it a more appropriate measurement tool. This, in conjunction with the present findings that the CFQ was able to explain unique variance in trait anxiety that was not captured by the ACS indicates that it can provide new insights that are currently obscured by the field's reliance on the

ACS. From another perspective, one could argue that since Focusing and Shifting also explained unique variance in trait anxiety that was not captured by the CFQ, there is merit to include all three as measures of attentional control. While we do not necessarily disagree with this, ultimately both perspectives converge on the importance of considering the CFQ, which has been overlooked until now.

The present study also showed that for all indices of attentional control included here, reappraisal did not account for the shared variance between trait anxiety and attentional control. This informs potential theoretical models that seek to explain why trait anxiety and attentional control are related, because it indicates that reduced use of reappraisal does not explain why poor attentional control is linked with increased anxiety. While reappraisal is a powerful emotion regulation strategy (Gross & John, 2003), more recently it has been suggested that rather than blanket use of one strategy, tailoring one's emotion regulation strategy to the context at hand is particularly adaptive (Gross, 2015). It may be that attentional control facilitates this flexibility in the selection of emotion regulation strategy, and the absence of this flexibility, rather than a reduced use of reappraisal per se, makes individuals prone to trait anxiety. Future research can test such possibilities.

In conclusion, cognitive failures as measured by CFQ scores had a unique relationship with trait anxiety above and beyond the variance explained by Shifting and Focusing. CFQ scores are predictive of important real-world outcomes such as crash risk, highlighting that trait anxious individuals may benefit from interventions to reduce crash risk. The CFQ has multiple measurement advantages over the ACS, and thus we recommend that future research investigating subjective attentional control and trait anxiety favour the CFQ. In addition, individual differences in the tendency to engage in reappraisal did not account for the shared variance between trait anxiety and any of the three indices of attentional control. This informs explanatory models for why trait anxiety is linked to poor attentional control.

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CRediT authorship contribution statement

Stephanie C. Goodhew: Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing – original draft. **Mark Edwards:** Conceptualization, Methodology, Writing – review & editing.

Declaration of competing interest

None to declare.

Data availability

The main data are available via OSF, see link in main body. Age and gender were not included in this raw data deposit to protect participant identity.

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