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Individual Differences in Anxiety and Worry, Not Anxiety Disorders, Predict Weakened Executive Control: Preliminary Evidence

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Abstract

People high in anxiety tend to be low in executive control. However, it is unclear whether this control impairment is more associated with high anxiety, or with anxiety disorder. We collected an internet sample of 29 individuals with diagnosed anxiety disorders and 97 without anxiety disorders, and measured their state and trait anxiety, worry, attentional control and cognitive failures using self-report measures. State anxiety, trait anxiety and worry all significantly predicted attentional control and cognitive failures. Having an anxiety disorder was not related to either attentional control or cognitive failures once anxiety or worry was controlled. Contemporary theories suggest poor executive control is a risk factor for anxiety disorders; these preliminary results suggest poor executive control may be a risk factor for high anxiety, but is not directly related to having a diagnosable anxiety disorder.
Key words: anxiety, worry, executive control, attentional control, cognitive failures.

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Novelty and Significance

What is already known about the topic?

- People high in anxiety tend to be low in executive control, the ability to control attention and thinking.
- Somo researchers have suggested that poor executive control increases the risk of developing anxiety disorders.

What this paper adds?

- Individual differences in anxiety and worry-proneness were much more strongly related to poor executive control than was having an anxiety disorder.
- This suggests that poor executive control might increase the risk of high anxiety, but does not directly increase the risk of developing a full-blown anxiety disorder.

Alongside its diagnostic symptoms, high anxiety is associated with several cognitive biases and impairments. This article examines the relationship between high anxiety and weak executive control.

The key diagnostic symptom of anxiety, and of generalized anxiety disorder in particular, is worry: task-irrelevant thought about negative events which may occur in the future (American Psychiatric Association, 2013; Meyer, Miller, Metzger, & Borkovec, 1990). Theorists have suggested (e.g. Eysenck & Calvo, 1992; Morris, Davis, & Hutchings, 1981) that this worry may tend to impair the attentional and/or executive control of high-anxiety individuals, because it occupies finite cognitive resources. While this chain of causation has not been upheld (Blankstein, Flett, Boase, & Toner, 1990; Forster, Nunez-Elizalde, Castle, & Bishop, 2015), several studies have

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confirmed that people high in anxiety tend to show weaker attentional control (e.g. Berggren & Derakshan, 2013), executive control (e.g. Visu-Petra, Miclea, & Visu-Petra, 2013), and working memory (e.g. Moran, 2016). More importantly, individuals with diagnosed anxiety disorders have also shown the same impairments (e.g. Blair *et alii*, 2012; Sylvester *et alii*, 2012). Two self-report measures relevant to executive control are the attentional control scale (Derryberry & Reed, 2002) and the cognitive failures questionnaire (Broadbent, Cooper, Fitzgerald, & Parks, 1982): the attentional control scale has shown moderate negative correlations with both state and trait anxiety (Derryberry & Reed, 2002; Quigley, Wright, Dobson, & Sears, 2017), and with low-level anxiety symptoms (Ólafsson *et alii*, 2011); the cognitive failures questionnaire also correlates moderately with state and trait anxiety (Broadbent *et alii*, 1982; Matthews & Wells, 1988; Righi, Mecacci, & Viggiano, 2009), and with worry (Merckelbach, Muris, Nijman, & de Jong, 1996). Because weaker executive control seems to correlate with anxiety (see also Eysenck, Derakshan, Santos, & Calvo, 2007), and also because it tends to exaggerate anxiety-maintaining threat-related cognitive biases (Booth, Mackintosh, & Sharma, 2017; Reinholdt-Dunne, Mogg, & Bradley, 2009), weaker executive control has been suggested as a possible risk factor for anxiety disorders (Hirsch & Mathews, 2012; Mathews & MacLeod, 2005; Ouimet, Gawronski, & Dozois, 2009).

One thing that remains unclear is whether such executive control impairments are a feature of anxiety disorders, or whether they are a feature of high anxiety and/or worry. In other words, would someone with a diagnosed anxiety disorder have much more impaired executive control than someone who has almost as high, but not clinically-diagnosable, anxiety and worry? They may not: anxiety disorders are increasingly conceptualized as regions on continua of symptom severity, rather than strict categories dividing disordered individuals from non-disordered individuals (Kertz, McHugh, Lee, & Björgvinsson, 2014; Olatunji, Broman-Fulks, Bergman, Green, & Zlomke, 2010; Ruscio, 2010). Answering this question will further our understanding of executive control impairments in anxiety, and of anxiety disorders in general; but more importantly, we cannot know whether weak executive control is a risk factor for anxiety disorders without knowing whether the two are actually associated.

A useful analogy may be drawn with another key cognitive feature of anxiety: attentional bias to threat. This bias has been extensively studied, and is thought to contribute to the appearance or maintenance of anxiety disorders (Mobini & Grant, 2007). However, there have been different opinions on whether this bias varies between diagnosed anxious patients and healthy high-anxious individuals. Twelve years ago, a meta-analysis (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007) concluded that attentional bias was not qualitatively different in these two groups, although individual studies have drawn the opposite conclusion (Martin, Williams, & Clark, 1991; Yiend *et alii*, 2015; see discussion by Goodwin, Yiend, & Hirsch, 2017). The important point here is that, if people with diagnosable anxiety disorders show the same attentional bias as people without diagnosable disorders, attentional bias's value as a diagnostic or etiological feature of anxiety disorders is unclear. In the same way, impaired executive control has been reported in subclinical anxiety (Berggren & Derakshan, 2013), in unrelated mental disorders (e.g. depression, Harvey *et alii*, 2004; schizophrenia, Lee & Park, 2005), and even in medical disorders such as HIV infection (Chang *et alii*, 2001). Again, if people with anxiety disorders show the same executive control impairments as people with different disorders or people with no disorder at all, the usefulness of such impairments as a risk factor for anxiety disorders is unclear.

As a preliminary investigation of this question, we collected an internet sample of diagnosed anxious patients and healthy controls, and assessed their state and trait anxiety, worry, attentional control and the frequency of their cognitive failures. Based on the literature discussed above, we suspected that anxiety and worry would more clearly predict attentional control and cognitive failures than would anxiety disorder diagnosis.

Method

Participants

The study was approved by the institutional review board. Participants were recruited by posting our survey link on websites and message groups in the UK and around the world for people with anxiety problems, and on general social media. The data were collected in 2013. Two hundred and one responses were collected; we excluded those who reported a psychiatric disorder other than an anxiety disorder, those who reported an anxiety disorder but did not clearly indicate which one, and one 12-year-old participant. The final sample for analysis included 126 participants with a mean age of 28.58 (*SD*= 9.16, range 16-62), including 102 females and 24 males; 71 participants were British. The sample included 29 individuals reporting a diagnosed anxiety disorder (2 agoraphobia, 6 social anxiety, 1 health anxiety, 1 panic attacks, 23 generalized anxiety disorder) and 97 reporting no diagnosed psychiatric disorder. See Table 1 for descriptive statistics for the two groups. Informed consent was obtained from all individual participants included in the study.

Table 1. Anxiety Disorder and No Disorder groups' demographics and scores on the study variables.

	Anxiety Disorder (*N*= 29)		No Disorder (*N*= 97)			
	M	*SD*	*M*	*SD*	t/χ^2	*p*
Age	29.55	10.34	28.28	8.81	0.65	.51
Gender Split	7M/22F	-	17M/80F	-	0.63	.43
State Anxiety	56.63	7.93	47.34	10.20	3.05	<.01
Trait Anxiety	61.56	6.22	49.11	12.09	5.33	<.01
Worry	66.12	8.34	55.89	12.93	4.01	<.01
Attentional Control	46.42	6.72	49.62	9.39	1.71	.09
Cognitive Failures	51.84	15.92	46.70	13.60	1.72	.09

Notes: Spielberger *et alii* (1983) presented norms of *M*≈ 36 (*SD*≈ 10.5) for state anxiety, and of *M*≈ 36 (*SD*≈ 9.5) for trait anxiety, for working adults aged 19-39; Startup and Erickson (2006) presented a norm of *M*= 42.67 (*SD*= 11.71) for worry, for working adults.

Design, Measures and Procedure

The study used a correlational design. The predictors were state and trait anxiety, worry, and anxiety diagnosis (anxiety disorder or no disorder). The outcomes were attentional control and cognitive failures.

After giving their consent, participants were asked to indicate with a Yes or No response whether they were currently formally diagnosed with anxiety or an anxiety disorder; following this, they were asked to specify the disorder. Next, they were asked to indicate whether they were formally diagnosed with any other psychiatric condition, and to specify which condition in the same way. They then completed the following scales:

They first completed the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), which consists two 20-item subscales. The state

anxiety subscale assesses anxiety 'right now, at this minute', whereas the trait anxiety scale assesses anxiety 'generally, in [one's] life'. Both subscales use a 1-4 response scale. Internal consistency was excellent in both subscales, Cronbach's α= .91 and .95 in this sample.

They then completed the Penn State Worry Questionnaire (Meyer *et alii*, 1990), which consists of 16 items such as "My worries overwhelm me" and "Many situations make me worry" and uses a 1-5 response scale. Internal consistency was excellent, α= .95.

Next, they completed the Attentional Control Scale (Derryberry & Reed, 2002), which consists of 20 items such as "My concentration is good, even if there is music in the room around me" and "I can quickly switch from one task to another" and uses a 1-4 response scale. Internal consistency was good, α= .87.

Finally, they completed the Cognitive Failures Questionnaire (Broadbent *et alii*, 1982), which asks the frequency of 25 common cognitive failures such as "Do you bump into people?" and "Do you find you forget appointments?" on a 1-5 scale. Scores were recoded so that higher scores indicate more frequent failures. Internal consistency was excellent, α= .92.

RESULTS

Table 2 presents the bivariate correlations and descriptive statistics for the study variables. Both attentional control and cognitive failures correlated significantly with state anxiety, trait anxiety, and worry (all $|rs| > .25$, $ps < .004$). Diagnosis had a marginal relationship with attentional control and cognitive failures, both ps= .09 (see Table 1). Controlling for age and gender, which have known associations with the study variables, has little effect on these results.

Table 2. Bivariate correlations, with 95% confidence intervals in square brackets, and descriptive statistics for all study variables (N= 126).

	2	3	4	5	*M*	*SD*
1. State Anxiety	.66 [.55, .75]	.57 [.44, .68]	-.26 [-.42, -.09]	.28 [.12, .44]	48.79	10.05
2. Trait Anxiety		.75 [.66, .82]	-.47 [-.59, -.32]	.52 [.38, .63]	51.97	12.19
3. Worry			-.44 [-.57, -.29]	.32 [.15, .47]	58.25	12.75
4. Attentional Control				-.50 [-.62, -.36]	48.88	8.93
5. Cognitive Failures					47.88	14.26

Note: All correlations significant, $p < .003$.

To test whether diagnosis had any ability to predict attentional control or cognitive failures over that of anxiety and worry, a series of hierarchical regression models were tested. In each model, state anxiety, trait anxiety or worry were entered in the first block with either attentional control or cognitive failures as the criterion. Then, diagnosis was added in a second block, to test for any improvement in the model's ability to predict the criterion. This improvement was nonsignificant in every case.

In the model regressing attentional control on state anxiety (R^2= .07, F[1, 124]= 8.91, p= .003), adding diagnosis (β= -.09) increased R^2 by .007 (F_{change}= 0.98, p= .32); state anxiety's effect remained significant (β= -.24, p= .01), but its β was not significantly larger than the β for diagnosis (t[123]= 1.02, p= .31). In the model regressing attentional control on trait anxiety (R^2= .22, F[1, 124]= 34.23, $p < .001$), adding diagnosis (β= .06) increased R^2 by .003 (F_{change}= 0.47, p= .49); trait anxiety's effect remained significant (β= -.49, $p < .001$), and its β was significantly larger than the β for diagnosis (t[123]=

3.69, p <.001). In the model regressing attentional control on worry (R^2= .19, F[1, 124]= 29.19, p <.001), adding diagnosis (β= -.004) increased R^2 by less than .001 (F_{change}= 0.002, p= .96); worry's effect remained significant (β= -.44, p <.001), and its β was significantly larger than the β for diagnosis (t[123]= 3.06, p= .003). In the model regressing cognitive failures on state anxiety (R^2= .08, F[1, 124]= 10.92, p= .001), adding diagnosis (β= .08) increased R^2 by .006 (F_{change}= 0.86, p= .35); state anxiety's effect remained significant (β= .26, p= .004), but its β was not significantly larger than the β for diagnosis (t[123]= 1.26, p= .21). In the model regressing cognitive failures on trait anxiety (R^2= .27, F[1, 124]= 44.98, p <.001), adding diagnosis (β= -.09) increased R^2 by .006 (F_{change}= 1.03, p= .31); trait anxiety's effect remained significant (β= .55, p <.001), and its β was significantly larger than the β for diagnosis (t[123]= 4.43, p <.001). Finally, in the model regressing cognitive failures on worry (R^2= .10, F[1, 124]= 13.78, p <.001), adding diagnosis (β= .05) increased R^2 by .002 (F_{change}= 0.32, p= .57); worry's effect remained significant (β= .30, p= .001) but its β was not significantly larger than the β for diagnosis (t[123]= 1.67, p= .10).

Our anxiety and worry scores were unusually high, even in the no disorder group (see Table 1). As we had collected much of our data from anxiety groups, this may indicate that some of our 'no disorder' participants may actually have had undiagnosed anxiety disorders. Ercan *et alii* (2015) suggested that a trait anxiety score of 44 or above indicated a possible anxiety disorder, so we restricted our no disorder group to participants with trait anxiety scores of 43 or less (N= 34). None of the correlations between anxiety or worry and the outcome measures differed significantly between this restricted no disorder group and the disorder group (using Fisher's r-to-z transformation, all zs <1, ps >.36), and the correlations between trait anxiety and the executive measures were particularly similar across the two groups (for the disorder group, trait anxiety correlated r= -.32 with attentional control and r= .41 with cognitive failures; in the restricted no disorder group, trait anxiety correlated r= -.32 with attentional control and r= .43 with cognitive failures). These results increase our confidence in the regression results above, suggesting that trait anxiety is a more important predictor of executive impairments than is anxiety disorder.

Discussion

In a heterogeneous internet sample, state anxiety, trait anxiety, and anxiety's key symptom -worry- were related to weaker attentional control and more cognitive failures. Having a diagnosed anxiety disorder, however, was not convincingly related to either outcome variable. These results suggest that having a diagnosed anxiety disorder is relatively unimportant in the expression of executive control impairments. Instead, such impairments seem associated with individual differences in anxiety and worry, suggesting that even subclinical variations in anxiety and worry can be associated with variations in control. This is also consistent with the idea that anxiety disorders are regions on continua of symptom severity, and are not categorical distinctions between disordered and non-disordered individuals (e.g. Kertz *et alii*, 2014).

This does not mean that poor executive control is not a risk factor for anxiety disorders, but it does mean the risk is indirect. Poor executive control is apparently associated with high anxiety rather than with clinical diagnosis; any relationship between the two (absent in the present study, but reported by Blair *et alii*, 2012; Sylvester *et alii*, 2012) is likely to be mediated by trait anxiety and/or worry. This may mean that

assessing (or remediating) executive control impairments may be less useful than directly assessing (or treating) worry and other symptoms.

Our results partially match those of Hallion, Tolin, Assaf, Goethe, & Diefenbach (2017), who found that trait anxiety was a more important predictor of response times in a Stroop task than was diagnosis (generalized anxiety disorder vs. healthy control). The Stroop task is often used as a measure of inhibition, which is a key component of executive control (Miyake *et alii*, 2000). However, these authors only analyzed response times to incongruent trials (trials where mismatching to-be-attended and to-be-ignored information are presented together): they presented the task without its control condition, meaning that inhibition and overall response speed are confounded. The same sample showed no relationship between anxiety and performance on another measure of inhibition, the Go/NoGo task, which further decreases our confidence in the Stroop results. However, the Go/NoGo task was designed for assessing inhibition in brain-injured patients, and may not be sensitive enough for measuring inhibition in brain-healthy individuals. Finally, worry was not related to either measure of inhibition in Hallion *et alii* (2017). Another reason why their study did not find the same relationships we did between anxiety, worry and control could be their smaller sample (56), although Hallion *et alii* (2017) were able to confirm their participants' diagnoses, which we could not do in our online study.

Of course, this study does not conclusively settle the issue of anxiety's relationship with executive control. One can fairly question the validity of any self-report measure of executive control (Quigley *et alii*, 2017; but see Reinholdt-Dunne, Mogg, & Bradley, 2013); a replication using appropriate behavioural measures of control is needed. Also, as mentioned above, our online approach meant we were unable to verify our participants' self-reported diagnoses, which is a serious limitation of these data. We present these findings as preliminary evidence concerning an as-yet little-studied topic, and we hope they encourage other researchers to study this issue.

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