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Does the attentional control scale measure attentional control? Evidence of no relationship with antisaccade performance.

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Abstract

Attentional control theory indicates a relationship between poor attentional control and heightened anxiety vulnerability. While attentional control is often assessed via self-report, there is inconsistency as to whether such self-report measures (in particular the Attentional Control Scale) provide an indication of genuine attentional control abilities. The present study sought to determine the presence or absence of a relationship between questionnaire and behavioural measures of attentional control, and to examine the association between these measures and psychological symptoms of depression, anxiety and stress, in a large non-clinical sample. Undergraduate students and individuals from the community (final sample n= 207) completed the Attentional Control Scale and measures of psychological distress (depression, anxiety, stress), as well as the antisaccade task as an objective measure of attentional control. Antisaccade performance was significantly associated with both anxiety (r= -.187) and stress (r= -.195). Self-reported attentional control also correlated significantly with all measures of psychological distress (r= -.307 to -.459). Critically however, there was no evidence for an association between full or subscale measures on the Attentional Control Scale and antisaccade performance (r= .027 to .078). Bayesian analyses indicated moderate to strong evidence that the null hypothesis is true (B_{10}= 0.094 - 0.161), suggesting that this finding was likely to represent the genuine absence of an association. The present study is consistent with growing evidence that self-reported measures of attentional control are not in fact measuring variation in attentional control abilities, and speaks to the importance of incorporating objective assessments of attentional control in research.

Key words: Attentional control; ACS; antisaccade; measurement; anxiety; psychological symptoms

Introduction

According to attentional control theory, goal-directed behaviour requires attentional control - that is, the inhibition of competing demands in order to focus on the task at hand, as well as the ability to switch or shift attention when required (Eysenck et al., 2007). Attentional control theory specifies that deficits in these aspects of attentional control are central to the development and maintenance of anxiety (Eysenck et al., 2007). In support of this assumption, a recent meta-analysis of 58 studies testing the association between measures of attentional control and anxiety found that participants with high anxiety showed a deficit in attentional control compared to participants with low anxiety (Shi et al., 2019). However, this effect was significantly stronger for self-report measures of attentional control such as the Attentional Control Scale (ACS; Derryberry & Reed, 2002), with a large effect size, than for behavioural measures such as the antisaccade task and attentional network task (ANT), with a small effect size. Given the disparate effect for self-report and objective measures of attentional control, it is important to consider the relative weight that evidence from these alternative sources should be given.

Researchers have questioned whether self-report measures of attentional control can fully capture attentional control processes, which may be at least partly outside conscious awareness (Quigley et al., 2017; Shi et al., 2019). It is therefore essential to determine whether behavioural and self-report measures of attentional control are related in order to determine whether they are indeed measuring the same construct. This will have implications for whether strong associations between self-report measures of attentional control and anxiety do indeed indicate an anxiety-related deficit in attentional control, or perhaps reflect another construct such as beliefs about control, that could be a product of anxiety or emotional vulnerability (Quigley et al., 2017). Indeed, research indicates that emotional vulnerability is associated with biased self-reports compared to objective reports in a range of areas including physical activity (Hamer et al., 2014) and quality of life (Atkinson et al., 1997), suggesting that anxiety may have systematic influences on subjective reports of experience (Wagner et al., 2006).

The ACS is a commonly used self-report measure of attentional control. In addition to an overall index, two sub-indices can be extracted: the ability to focus attention, and the ability to shift attention to a goal-related task (Derryberry & Reed, 2002). To date six papers have tested the relationship between ACS scores and behavioural measures of attentional control. Of these, three found associations between ACS and at least some behavioural measures of attentional control (Judah et al., 2014; Muris et al., 2008; Reinholdt-Dunne et al., 2013), and three did not (Quigley et al., 2017; Reinholdt-Dunne et al., 2009; Verstraeten et al., 2010). Two studies found associations between ACS-focusing subscale scores and behavioural measures of attentional control, of which one found a small correlation with ANT scores (Reinholdt-Dunne et al., 2013), and the other found a moderate correlation with antisaccade task scores (Judah et al., 2014). A third study found associations between ACS total score and the Test of Everyday Attention for Children (TEA-Ch) total score in primary-school-aged children, although the correlations were small (Muris et al., 2008). In the other three studies conducted in this area, no association was found between ACS total, shifting or focusing indices and behavioural measures of attention including the TEA-Ch (Verstraeten et al., 2010), ANT (Reinholdt-Dunne et al., 2009) and antisaccade task (Quigley et al., 2017).

Given these inconsistencies, it is important to determine whether questionnaire-based measures of attentional control are actually measuring the same construct as behavioural measures of attentional control. If ACS scores are not in fact associated with behavioural measures of attentional control, then these measures may be tapping into different constructs, and would perhaps suggest a different interpretation of the strong association between self-report measures of attentional control and anxiety (Shi et al., 2019).

The aim of the present study was therefore to test the relationship between questionnaire and behavioural measures of attentional control, and to test whether either of these measures are associated with psychological symptoms of depression, anxiety and stress, in a large unselected sample. Importantly, we incorporated Bayesian analyses to determine whether any non-significant effects are more likely to represent a failure to attain a significant finding, or the genuine absence of a relationship. If the ACS or its subscale measures are related to inhibitory attentional control as assessed with the antisaccade task, this should be revealed via a significant positive relationship between these self-report and behavioural measures, and Bayes factors indicating evidence in favour of the alternative hypothesis. However, if the ACS is unrelated to behavioural measures of attentional control then no significant relationship should be revealed between these factors, and Bayes factors would indicate evidence in favour of the null hypothesis.

Method

Participants

A total of 258 participants were recruited through undergraduate psychology participant pools at two large Australian Universities, and via social media. The project was approved by the respective University human research ethics committees. Participants completed a battery of questionnaires and cognitive measures as part of a larger project conducted under the Cognition and Emotion Research Collaboration Initiative (CERCI). Only measures that are pertinent to the present aims are described here. Using G*Power (Faul et al., 2007) to calculate a power analysis with $p = .05$ and $\beta = 0.8$, the sample size was deemed adequate to detect the small effect correlations previously reported between the ACS full scale and antisaccade accuracy ($r = 0.25$; Judah et al., 2014), even after an anticipated 30% sample size reduction due to inadequate task completion or exclusion criteria.

Questionnaire Measures

Demographic questions included age, gender, English fluency, education, and ethnicity. In order to ensure that participants comprehended questionnaires and task instructions, participants were excluded if they indicated that their English was not very fluent.

Participants completed the 20-item Attentional Control Scale (ACS; Derryberry & Reed, 2002) as a questionnaire-based measure of attentional control. Participants rate the degree to which they endorse each statement on a Likert scale from 'almost never' to 'always'. In the present study, a 6 point-Likert scale was used to increase sensitivity of the measure (Leung, 2011). A higher total ACS score is taken to indicate greater attentional control. We used Ólafsson et al.'s (2011) method for calculating the focusing (9 items: 1-8, 12) and shifting (10 items: 10-11, 13-20) subscales, as well as ACS total score (sum of these 19 items). The alternative calculation method proposed by Judah et al. (2014) yielded an identical pattern of results (see Supplementary File A). Internal consistency was acceptable for all ACS indices (α = .725 - .847). Means and internal consistency values for the ACS scale and sub-scales are reported in Table 1.

Participants also completed the well-used and validated depression, anxiety and stress scale (DASS 21; Lovibond & Lovibond, 1995) as a measure of trait depression, anxiety and stress. This measure showed good internal consistency for each subscale in the present study (Cronbach's alpha for Depression = .92, Anxiety = .88, Stress = .89).

Behavioural Measure of Attentional Control

A version of the antisaccade task used by Miyake et al. (2000) was utilised as a behavioural measure of attentional control. Trials began with a small fixation cross, presented in the centre of the screen for 1500-3500ms (random 250ms increments) before being replaced by a 20mm x 20mm black square cue, 85mm to the left or right of where the fixation cross had appeared. The black square was presented for 225ms, after which it was replaced by a 5mm long black target arrow, pointing to the left, right, or up. This target arrow appeared on the opposite screen position to the black square, for 150ms, after which the target arrow was masked with '##'. Participants indicate the direction of the arrow by pressing the corresponding key on their keyboard, and a new trial began after a 500ms inter-trial interval. Participants must successfully inhibit saccades towards the black square cue, and direct their attention to where the arrow will appear in order to successfully identify the target arrow, given the brief target presentation time. A total of 90 trials were presented. A higher proportion of targets correctly identified, as per Miyake et al. (2000), was used as an indicator of greater attentional control. A minimum accuracy rate of 40% was utilised for the antisaccade task, to exclude chance (33.3%) responding. A random split-half of antisaccade trials was computed for the remaining participants which indicated reasonable reliability (r = .704, $p < .001$).

Procedure

Participants completed the study online on their own computers via Inquisit 4.0.8 (2015). Testing was conducted in a single, one-hour session. Throughout the study, stimulus size was adjusted according to the specifications of the participant's screen, to ensure consistency across participants. Participants first read the information statement, and confirmed that they understood the study requirements and their right to withdraw at any time. Participants then completed the questionnaire measures, followed by a number of cognitive assessment tasks, including the antisaccade task. Participants were first presented with practice trials to familiarise themselves with the task. Participants then completed the antisaccade task itself. Upon completion of the experiment, participants received debrief information.

Results

Demographics

A total of 50 participants were excluded due to poor antisaccade accuracy. This exclusion rate is to be expected given the difficulty of the task and that it was delivered online. One additional participant with not very fluent English was excluded. The final sample included 207 individuals (148 female), with a mean age of 22.4 (SD = 7.07). Most participants reported secondary school as their highest educational level (67.6%), and generally self-identified as Caucasian (42.0%), Australian (30.0%) or Asian (15.9%). The final dataset is available from the authors upon request.

Correlations

To test the relationship between questionnaire and behavioural measures of attentional control, Pearson's bivariate correlations (with 95% confidence intervals) were conducted between total and subscale scores of the ACS, and antisaccade accuracy scores, and effect sizes were evaluated according to Cohen's (1992) guidelines. To determine the degree to which the data supported the null hypothesis (i.e. that questionnaire and behavioural measures of attentional control were not correlated) or the alternative hypothesis (i.e. that questionnaire and behavioural measures of attentional control were correlated), Bayes factors supporting the alternative hypothesis (BF_{10}) were computed using JASP (2020). A Bayes factor for the alternative hypothesis indicates the degree to which the data is consistent with the alternative hypothesis, compared to the null hypothesis (Quintana & Williams, 2018). As per convention, $BF_{10} \leq 0.33$ provides at least moderate evidence in favour of the null hypothesis, while $BF_{10} \geq 3$ provides at least moderate evidence in favour of the alternative hypothesis (JASP guidelines; see also Lee & Wagenmakers, 2013).

As can be seen in Table 1, the ACS indices did not correlate with accuracy on the antisaccade task (*p*s > .1). Further, examination of the Bayes factors ($B_{10} = 0.094 - 0.132$) associated with these effects provided moderate to strong evidence that the null hypothesis is true, that is, that questionnaire and behavioural measures of attentional control were not correlated.

[INSERT TABLE 1 NEAR NERE]

To examine the relationship between measures of attentional control and psychological symptoms, bivariate correlations between DASS scores and measures of attentional control were conducted. Antisaccade accuracy did not correlate with self-reported depression symptoms (r = -.129, p = .064, B_{10} = 0.479), with a Bayes factor indicating anecdotal evidence in favour of the null hypothesis. However, antisaccade accuracy was significantly associated with self-reported anxiety (r = -.187, p = .007, B_{10} = 3.277) and stress (r = -.195, p = .005, B_{10} = 4.504) symptoms, with Bayes factors indicating moderate evidence in favour of the alternative hypothesis. ACS indices and subscales were all correlated with self-reported depression, anxiety and stress (r = -.307 to -.459, ps < .001), with Bayes factors indicating extreme evidence in support of the alternative hypothesis ($B_{10} = 2.00 \times 10^3$ to $B_{10} = 2.48 \times 10^9$).

Discussion

The aim of the present study was to investigate the relationship between questionnaire and behavioural measures of attentional control, and determine whether these measures of attentional control are associated with psychological symptoms of depression, anxiety and stress. We found moderate to strong evidence of no relationship between questionnaire measures of attentional control (ACS scores, as well as shifting and focusing attention indices) and a behavioural measure of attentional control (antisaccade task accuracy). This is consistent with some previous research in this area (Quigley et al., 2017; Reinholdt-Dunne et al., 2009; Verstraeten et al., 2010). Other studies have found some evidence of a relationship between behavioural and self-report measures of attentional control, however each found some indices were associated whilst others were not (Judah et al., 2014; Muris et al., 2008;

Reinholdt-Dunne et al., 2013), and the researchers have cautioned against over-interpretation of these small findings (Muris et al., 2008).

Consistent with the predictions of attentional control theory (Eysenck et al., 2007) we found evidence of a relationship between impaired attentional control and increased anxiety and stress, which was significant across both questionnaire and behavioural measures of attentional control. These findings are consistent with the position that poor attentional control is a feature of higher trait anxiety and stress levels. These findings are broadly consistent with Shi et al.'s (2019) meta-analysis in that the association between behavioural measures of attentional control and anxiety was relatively small, while the relationship between self-report attentional control and anxiety is larger.

The present evidence for no association between self-report and behavioural measures of attentional control adds weight to the mounting evidence that questionnaire-based tools that purportedly measure attentional control do not in fact appear to be tracking objective attentional control abilities. This has implications for how the association between self-reported attentional control and psychological symptoms of anxiety and depression is interpreted. If the ACS is not providing a genuine indication of attentional control abilities, then this holds implications for the weight of evidence regarding the association between attentional control and anxiety in the literature more broadly. Researchers have suggested that the ACS may instead measure beliefs about attentional control ability, and in those with heightened anxiety vulnerability may indicate increased metacognitive distortions regarding cognitive abilities independently of objective attentional control (Quigley et al., 2017). Further research delineating the underlying constructs (or epiphenomena) that are being measured by the ACS is warranted.

In summary, the present study found evidence that neither the full-scale measure of the ACS, nor any subscale measures are related to inhibitory attentional control as indexed by the antisaccade task, that was itself shown to be associated with anxiety. This adds to a growing body of research indicating no association between self-report and behavioural measures of attentional control, casting further doubt on whether individuals are capable of objectively reporting on their attentional control abilities, and thus queries the validity of the ACS, and associated findings. These findings highlight the critical importance of incorporating behavioural measures of attentional control when attempting to quantify such abilities.

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Table 1

Pearson correlations (with 95% confidence intervals and Bayes factors) between behavioural and self-report measures of attentional control, and self-report measures of psychological symptoms

		ACS total	ACS focus	ACS shift	Anti Acc	DASS-D	DASS-A	DASS-S
Anti Acc	r	.063	.078	.027	-			
	[95% CI]	[-.074, .198]	[-.059, .121]	[-.110, .163]	-			
	BF_{10}	.132	.161	.094	-			
DASS-D	r	-.409**	-.370**	-.341**	-.129	-		
	[95% CI]	[-.517, -.289]	[-.482, -.246]	[-.456, -.215]	[-.261, .008]	-		
	BF_{10}	1.04×10^7	2.81×10^5	2.50×10^4	0.479	-		
DASS-A	r	-.367**	-.332**	-.307**	-.187**	.703**	-	
	[95% CI]	[-.479, -.243]	[-.448, -.205]	[-.426, -.178]	[-.315, -.052]	[.627, .766]	-	
	BF_{10}	2.10×10^5	1.21×10^4	2.00×10^3	3.277	1.12×10^{29}	-	
DASS-S	r	-.459**	-.427**	-.370**	-.195**	.759**	.822**	-
	[95% CI]	[-.560, -.344]	[-.532, -.309]	[-.482, -.246]	[-.323, -.060]	[.695, .811]	[.772, .862]	-
	BF_{10}	2.48×10^9	6.51×10^7	2.76×10^5	4.504	6.33×10^{36}	4.17×10^{48}	-

Mean (SD)	43.42 (12.57)	18.28 (7.80)	25.14 (6.61)	0.658 (.121)	13.14 (5.47)	12.78 (4.96)	14.86 (5.12)
Cronbach's α	.847	.828	.725		.923	.875	.895

Notes: ACS = Attentional Control Scale calculated according to the method described by Ólafsson et al. (2011), Anti Acc = accuracy score on the antisaccade task, DASS = depression anxiety stress scale (D = depression, A = anxiety, S = stress subscales), r = Pearson's r. N = 207 for all correlations. * < .05, ** <.01, *** < .001

Supplementary File A

Alternative calculation of Attentional Control Scale indices using Judah et al.'s (2014) method

Two different methods of calculating the Attentional Control Scale subscales have been described in the literature (Judah et al., 2014; Ólafsson et al., 2011; Quigley et al., 2017). In addition to the calculation method proposed by Ólafsson et al. (2011) and described in the main manuscript, we also calculated the Attentional Control Scale focusing and shifting subscales, as well as the total score, according to the method proposed by Judah et al. (2014).

Judah et al.'s (2014) focusing subscale consists of 6 items (items 1, 2, 3, 6, 7, and 8 from the original scale) and the shifting subscale consists of 5 items (items 10, 13, 17, 18, and 19 from the original scale). The corresponding Attentional Control Scale total score was calculated as a sum of these subscales (11 items).

Internal consistency was acceptable for all ACS indices calculated according to the Judah et al. (2014) method (α = .740 - .836). Means and internal consistency values for each ACS scale and sub-scales are reported in Supplementary Table 1.

As can be seen in Supplementary Table 1, the pattern of (lack of) association between ACS indices and antisaccade accuracy was identical for both ACS calculation methods. The pattern of association between ACS indices and psychological symptoms of depression, anxiety and stress was also identical for both ACS calculation methods.

Supplementary Table 1

Pearson correlations (with 95% confidence intervals and Bayes Factors) between behavioural and self-report measures of attentional control, and self-report measures of psychological symptoms

		ACS1 total	ACS1 focus	ACS1 shift	ACS2 total	ACS2 focus	ACS2 shift	Anti Acc	DASS-D	DASS-A	DASS-S
Anti Acc	r	.063	.078	.027	.110	.108	.064	-			
	[95% CI]	[-.074, .198]	[-.059, .121]	[-.110, .163]	[-.027, .243]	[-.029, .241]	[-.073, .199]				
	BF_{10}	.132	.161	.094	.302	.298	.132				
DASS-D	r	-.409**	-.370**	-.341**	-.403**	-.374**	-.267**	-.129	-		
	[95% CI]	[-.517, -.289]	[-.482, -.246]	[-.456, -.215]	[-.261, .008]	[-.486, -.250]	[-.389, -.136]	[-.261, .008]			
	BF_{10}	1.04×10^7	2.81×10^5	2.50×10^4	5.88×10^6	3.74×10^5	160.51	0.479			
DASS-A	r	-.367**	-.332**	-.307**	-.368**	-.338**	-.248**	-.187**	.703**	-	
	[95% CI]	[-.479, -.243]	[-.448, -.205]	[-.426, -.178]	[-.315, -.052]	[.627, .766]	[-.372, -.116]	[-.315, -.052]	[.627, .766]		

	BF_{10}	2.10 x 10^{5}	1.21 x 10^{4}	2.00 x 10^{3}	2.29 x 10^{5}	1.94 x 10^{4}	55.969	3.277	1.12 x 10^{29}		
DASS-S	r	-.459**	-.427**	-.370**	-.445**	-.424**	-.278**	-.195**	.759**	.822**	-
	[95% CI]	[-.560, -.344]	[-.532, -.309]	[-.482, -.246]	[-.323, -.060]	[.695, .811]	[.772, .862]	[-.323, -.060]	[.695, .811]	[.772, .862]	
	BF_{10}	2.48 x 10^{9}	6.51 x 10^{7}	2.76 x 10^{5}	4.77 x 10^{8}	4.77 x 10^{7}	304.02	4.504	6.33 x 10^{36}	4.17 x 10^{48}	
Mean (SD)		43.42 (12.57)	18.28 (7.80)	25.14 (6.61)	24.57 (8.09)	11.49 (5.87)	13.09 (3.99)	0.658 (.121)	13.14 (5.47)	12.78 (4.96)	14.86 (5.12)
Cronbach's α		.847	.828	.725	.814	.836	.740		.923	.875	.895

Notes: ACS1 = version of Attentional Control Scale calculation reported by Ólafsson et al. (2011) and described in the main manuscript, ACS2 = alternative version of Attentional Control Scale calculation reported by Judah et al. (2014), Anti Acc = accuracy score on the antisaccade task, DASS = depression anxiety stress scale (D = depression, A = anxiety, S = stress subscales), r = Pearson's r. N = 207 for all correlations.

* < .05, ** <.01, *** < .001