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The effects of active worrying on working memory capacity

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This work was supported by Fund for Scientific Research-Flanders (FWO, #G094012N) awarded to Ernst H. W. Koster, Gilles Pourtois, & Nazanin Derakshan.

Abstract

According to the Attentional Control Theory of Anxiety (Eysenck, Derakshan, Santos & Calvo, 2007), worry, a crucial component of anxiety, impairs task performance outcome(s) through its direct effect on working memory capacity (WMC), by using up the limited resources available for performance thus reducing attentional control. We tested this hypothesis in the current study by examining the causal influence of active worrying on WMC in a sample of undergraduate university students assigned either to a worry condition (n = 32) in which state worry was induced or to a non-worry control condition (n = 32). Participants performed a change detection task before and after the worry/control manipulation. Mediation analyses showed that the level of self-reported worry mediated the effects of condition on change in WMC as demonstrated by the significant indirect effect of worry and the resulting non-significant direct effect of condition on change in WMC. Similar results were obtained when using state anxiety measures as mediating factors. Results of the current study are amongst the first to demonstrate that worry impairs WMC and as such have important implications for understanding the impact of worry in educational as well as clinical outcomes.

Keywords: anxiety, worry, working memory capacity, change detection, attentional control

Introduction

Worry has been described as a state of experiencing uncontrollable, apprehensive, and intrusive negative thoughts about the future (Borkovec, Robinson, Pruzinsky, & DePree, 1983). It is considered as a main cognitive characteristic of anxiety (Eysenck, 1982; Mathews, 1990), believed to hijack important attentional resources from a limited working memory capacity (WMC) system, leaving fewer resources available for task demands, thus reducing attentional control (e.g., Derakshan & Eysenck, 2009; Berggren & Derakshan, 2013; Hirsch & Mathews, 2012). According to the attentional control theory of anxiety (ACT; Eysenck, Derakshan, Santos, & Calvo, 2007), worry is a key mechanism explaining why efficient processing of the main executive functions of working memory are hampered in anxiety, leading to impaired or inefficient task performance.

While worry provides a mechanism by which the effects of anxiety on cognitive performance outcomes can be explained, there have been relatively few studies examining the possible causal influence of worry on cognitive performance. Hayes, Hirsch, and Mathews (2008) assessed the effects of worrying on performance using a random key-pressing task measuring attentional control. During this task, participants were asked to press any one of 15 buttons available upon hearing a beep. Randomness of button press was interpreted as a measure of attentional control since producing a more novel and random sequence requires a greater level of attention as compared to following a regular and practiced sequence. In that study, participants were assigned to a 'worry' condition where they were instructed to think of a personally relevant worrying concern and a 'control' condition where they were asked to think of a personally relevant positive future event while completing this task. Hayes et al. (2008) found that high trait worry was associated with fewer random button presses. Furthermore, high trait worriers produced less random sequences during the worry condition as compared to the control condition, which was not the case for the low worriers. This latter result was consistent with the prediction that state worry reduces processing efficiency, especially in individuals with trait characteristics compatible with this thinking style (see Eysenck et al., 2007). This finding was replicated in a sample of generalized anxiety disorder (GAD) patients (see Stefanopoulou, Hirsch, Hayes, Adlam, & Coker, 2014) who conducted the same task with the addition of completing an n-back working memory task first. In this study, working memory performance was also shown to be affected with GAD participants performing worse on the n-back task than control subjects.

More recently, two studies have looked at how trait vulnerability to worry modulates cognitive as well as neural processes related to attentional control. Stout, Shackman, Johnson and Larson (2015) using an emotional working memory (WM) task in healthy participants assessed the role of worry and anxiety in relation to working memory on filtering efficiency using an emotional face change detection task with faces depicting threatening and neutral expressions. In this task, participants were required to focus on the target faces and indicate if they had changed in a subsequent recall phase while ignoring the distracter faces. Results of this study demonstrated an increased filtering cost both for neutral and threat distracters in high trait anxious individuals. Furthermore, trait worry also increased filtering costs but for the threat related distractors only. In another study, using a modified version of the flanker task under low and high working memory load, where angry and neutral facial expressions of emotions served as distractors, Owens, Derakshan and Richards (2015) found that trait vulnerability to worry was associated with a greater recruitment of the N2 ERP component upon the inhibition of distractors with this neurophysiological effect being greater under high working memory load, providing support for the notion that trait worry reduces attentional control especially under conditions where attentional resources compete to meet task demands.

Extending recent demonstrations that trait vulnerability to worry reduces processing efficiency, the current study sought to establish that this effect can be explained through the effect of worry on WMC. Recent theoretical accounts (see Shipstead, Lindsey, Marshall, & Engle, 2014) have argued that WMC, i.e., the *efficacy* by which goal relevant information is attended, stored, and maintained while task irrelevant information is suppressed, is strongly related to attentional control. This suggests that in line with former predictions of ACT, active worrying should reduce WMC. To our knowledge, no study has directly examined the impact of active worrying on WMC in an unselected population. However, this research question is key in gaining a better understanding of how anxiety related impairments on cognitive performance in situations such as examinations for example, where the efficient regulation of attentional control is needed under competing task demands, could emerge. We assessed WMC using a modified visual change detection task (CDT) with (neutral) shapes (Owens, Koster & Derakshan, 2013) that was based on (Vogel, McCollough, & Machizawa, 2005). During this task, participants were instructed to remember the orientation of shapes and monitor change occurring between the sample display and the test display. In order to observe the influence of active worrying, we used a worry manipulation similar to Hayes et al. (2008). In a between subjects design, participants were asked to focus on either a worrisome concern (worry condition) or positive future event (control condition). They performed the CDT before and after the manipulation. This enabled us to test how active worrying causally influenced WMC. During the experiment, mood ratings in response to worry were also obtained. We predicted that increased worrying would be related to impaired WMC with reductions or limited improvements in WMC post vs. pre manipulation for the worry as compared to control condition.

Method

Participants

Sixty-four participants (27 male, 37 female) aged between 18-53 (M = 27, SD = 8) were recruited via advertisements from the campus of Birkbeck University of London (N = 39) and Ghent University (N = 25). They were compensated 5 GBP/5 Euro or given course credit for their contribution. The first participant was randomly assigned to either the 'Worry' (N = 32) or a 'Control' (N = 32) condition and subsequent participants were assigned to the different conditions alternately. Data from 10 participants were excluded either due to difficulties during the manipulation (i.e., they could not think of a personally relevant worrisome future event, N = 3), poor accuracy on the change detection task (less than 50% accuracy, N = 4), high response bias (false alarms more than 2.5 SD of the mean, N = 3), leaving a final sample of 54 individuals (26 in the 'Worry' and 28 in the 'Control' condition).

Materials and Procedure

Questionnaires. Participants completed the trait and state anxiety scales of the STAI (State Trait Anxiety Inventory; STAI; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983), the trait worry (Penn State Worry Questionnaire; PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) and the trait rumination scales (Ruminative Responses Scale, RRS; Nolen-Hoeksema & Morrow, 1991). During the experiment state worry and state anxiety were also assessed via 0 – 100 mm visual analogue scales (VAS; 0 = not at all, 100 = extremely).

Change Detection Task. A schematic overview of the trial sequence is presented in Figure 1. Each trial started with a fixation cross with an arrow above pointing either to the right or left (700 ms). This arrow served as cue and participants were informed to attend to the side of the screen indicated by this symbolic cue. Afterwards, either 2 or 4 rectangles appeared at the right and left side of the screen for 100 ms (3° away from the fixation cross, within a region of 4° x 7.2°; memory array). Participants were asked to memorize the orientation of the red rectangles on the attended side. After a retention interval of 900 ms, the rectangles reappeared at the right and left side of screen (test array). Participants were instructed to indicate whether the orientation of one of the (four or two) red rectangles they had memorized had changed or not within a two second interval, as accurately as possible.

The task included two item, four item, and distractor conditions. In the two item and four item conditions, all rectangles were red in color while the distractor condition included two blue rectangles as distractors in addition to the two red rectangles. In each condition, the rectangles appeared on random positions with a minimum of 2° distance from each other. There were 4 possible orientations for the rectangles: vertical, horizontal, 45° left and 45° right tilted. All possible conditions were randomly distributed within the task. There were 4 possible orientations for the rectangles: vertical, horizontal, 45° left and 45° right tilted. Fitting these criteria, we had 98 stimuli set for the four item, 105 stimuli set for the two-item and 101 stimuli set for distractor condition. The same stimuli set was not presented more than once during the task. All possible conditions were randomly distributed within the task.

The task included four experimental blocks including 48 trials each (in half of the trials orientation of a rectangle has changed and in the other half it remained the same). Participants practiced the task until they reached an accuracy level of > 50% before starting the main experimental trials.

Insert Figure 1 here

Procedure. Participants first read and signed the consent form. Then, they completed STAI-TA, PSWQ and RRS. Next, they performed the CDT, after which they provided mood ratings using VAS on the extent to which they felt worried, relaxed, happy and anxious (pre-manipulation). Afterwards, participants were assigned either to Worry or Control condition where they were asked to think of a personally relevant future event (in line with Stefanopoulou et al., 2014). In the Worry condition participants focused on a personal concern or a worrisome event, whereas the Control condition participants focused on a positive event. Since worry is strongly related to low self-esteem and beliefs about personal inadequacies (Davey & Levy, 1998), finding a personally relevant future scenario was strongly emphasized. Next, participants were shortly interviewed by the experimenter about these events for approximately 2 minutes. They were asked to discuss the positive (control condition) or negative (worry condition) aspects of the events they were focusing on. Once the interview was terminated, participants were told to actively keep thinking about the future events they just described until the end of the experiment. Then, mood ratings were taken for the second time (post-manipulation) alongside a question about the personal relevance of the event they had described. In addition to the mood ratings, participants also completed STAI-SA. Finally, they performed the CDT for the second time after which mood ratings were assessed for the final time (after the task). In the end, participants were asked to rate the frequency by which they had thought about the personal topic they had described earlier.

Data Analytic Approach. In order to assess performance on the CDT, we calculated WMC scores via the widely used formula (Pashler, 1988): K = S x (H - F)/(1-F) where K (WMC) is calculated as a function of S: the set size of the array, H: the observed hit rate and F: proportion of false alarms. In keeping with Lee, Cowan, Vogel, Valle-Inclan and Hackley (2010) and Owens et al. (2013), we calculated WMC for the 4-item condition, eliminating possible ceiling or floor effects which can occur from two-item condition or distracter condition. In order to assess the level of worry during the task performance, we averaged the VAS scores for the worry ratings obtained after the manipulation (before starting CDT for the second time) and at the end of the task to produce an average score of worry (worry level). Since worry is defined as a more verbal and cognitive form of state anxiety (Mathews, 1990; Eysenck et al., 2007), we also calculated the same index for the anxiety ratings (anxiety level). In addition, STAI-SA scores were also included in our analysis. Strong correlations were observed amongst levels of worry, STAI-SA and VAS measures of anxiety (worry and VAS anxiety, $r(54) = .83$, $p < .001$; worry and STAI-SA, $r(54) = .73$, $p < .001$; VAS anxiety and STAI-SA, $r(54) = .62$, $p < .001$). Other VAS ratings on relaxed mood and happiness were obtained to reduce the sole focus on anxiety which could enhance anxious mood. Since the focus of the study was change in WMC as a function of the worry manipulation, we calculated change scores in WMC by subtracting the scores at pre-manipulation from the scores at post-manipulation. Larger change in WMC scores indicated improved performance at post-manipulation compared to pre-manipulation. Due to the variability in responding to mood manipulation (*cf.* Grol, Koster, Bruyneel & De Raedt, 2014) further analyses focused on the relationship between condition and WMC considering the level of worry or anxiety.

To test the main hypothesis, mediation analysis with condition as the independent variable, worry level as the mediating (intervening) factor, and change in WMC as dependent variable was conducted. Figure 2 depicts the tested model. In order to test the conditions of the mediation model (Mathieu & Taylor, 2006), significance of the indirect effect (path *ab*), the total effect (effect of condition on change in WMC scores without taking worry level into account (path *c*); and the direct effect (i.e., effect of condition on WMC scores after considering worry level (path *c'*) were investigated.

Significance of the indirect effect was tested using a bootstrapping approach (Preacher & Hayes, 2008) via random resampling (Hayes, 2013). We estimated 10000 bias-corrected bootstrap 94% confidence intervals, excluding 0 for the indirect effect to be significant. **Significance of the indirect effect was tested using a bootstrapping approach (Preacher & Hayes, 2008) via random resampling (Hayes, 2013). We estimated 10000 bias-corrected bootstrap 94% confidence intervals, excluding 0 for the indirect effect to be significant. These settings were chosen to decrease the range of the confidence intervals, which increases the stability of the results.**[1] Significance of total effect (path c) and direct effect (path c') were tested and reported via regression coefficients. Similar mediation analyses were repeated with STAI-SA and VAS anxiety as intervening variables, separately. All mediation models were controlled for heteroscedasticity. Analyses were conducted using IBM SPSS 19 and the macro PROCESS 2.13.2 (Hayes, 2013).

Insert Figure 2 here

Results

Condition Description

Participants in the Worry and Control condition did not differ from each other on STAI-TA, PSWQ or RRS (all *t*s < 1, *NS*). There were no group differences in age ($t < 1$, *NS*) or gender distribution (χ^2 (1, $N = 54$) = .32, $p = .57$).

Mood induction Check

Mood ratings at the beginning of the experiment (pre-manipulation) were compatible across condition groups, all *t*s < 1.2, *NS.* As expected, participants in the Worry condition were more worried, less relaxed, more anxious, and less happy than in the Control condition (all *t*s > 4.5, all *p*s <.001) after the manipulation (post manipulation; see table 1 for descriptive statistics), although there was substantial individual variability within conditions. Furthermore, the Worry condition had higher STAI-SA scores ($M = 48$, $SD = 9$) relative to the Control condition ($M = 36$, $SD = 11$); $t(52) = 4.39$, $p < .001$). Participants in the worry condition reported that the selected future event was highly personal, and reported that on average they spent about 67% of the time thinking about their personal topic at post manipulation. There were no condition differences in ratings of relevance, t (52) = 1.38, $p = .17$, or on time spent thinking about their personal topic, $t < 1$, *NS*. At the end of the experiment, participants in the Worry condition were still significantly more worried, less relaxed, more anxious, and less happy compared to participants in the Control condition: all *t*s > 3.7, all *p*s < .01 (see Table 1).

Insert Table 1 here

Change Detection Task

The Worry and Control condition did not significantly differ from each other on WMC prior to the experimental manipulation, $t < 1$, *NS* (Worry: $M = 1.42$, $SD = .76$; Control: $M = 1.53$, $SD = 1.05$). Furthermore, participants did not differ from each other based on the location they were recruited from (UK or Belgium) in terms of WMC at pre-manipulation, post-manipulation or pre to post change scores (all *t*s < .1, *NS).*

Results of the bias-corrected bootstrapping procedure showed that the indirect effect of condition on change in WMC via Worry was significant (path *ab*, $b = -.41$; boot 94% CI = [-1.0295, -.0045]) with medium-to-large effect size ($K^2 = .18$, boot 94% CI = [.0233, .4082]; Preacher & Kelley, 2011)[2]. The direct effect (path *c',* $b = .06$, $t(51) < 1$) was not significant. The total effect (path *c,* $b = -.35$, $t(52) = -1.47$, $p = .15$) did not reach significance. These results indicate that worry mediated the relationship between condition and change in WMC. Figure 3a shows the relationship between the level of worry and the change in WMC in each condition.

Results of the bias-corrected bootstrapping procedure also showed significant indirect effects of condition on change in WMC via VAS Anxiety level (path *ab*, $b = -.48$; boot 94% CI = [-1.0190, -.1516] and via STAI-SA (path *ab*, $b = -.26$; boot 94% CI = [-.8396, -.0533] separately. Both effects represented medium to large effect sizes (for VAS Anxiety, $K^2 = .24$, boot 94% CI = [.0788, .4486]; for STAI-SA, $K^2 = .14$, boot 94% CI = [.0331, .3403]; Preacher & Kelley, 2011). The direct effects were not significant in either of the analyses (path *c',* all *t*s < 1, *NS*). Results indicate that the level of state anxiety scores assessed via VAS anxiety and also STAI-SA mediated the relationship between condition and WMC change (See figure 3b –for anxiety level-and 3c –for STAI-SA- for the relationship between state-anxiety and change on WMC in the worry and control conditions separately).

It is noteworthy to mention that our mediation model did not fit the criteria of traditional full mediation model where the total effect should be significant (Baron & Kenny, 1986). However, recent theoretical approaches on mediation analyses (Mathieu & Taylor, 2006; Hayes, 2009) have offered new insights into the validity of mediation where the significance of the total effect is no longer a prerequisite, usually referred to as an indirect effect model (Mathieu & Taylor, 2006). In an indirect effect model, a significant indirect effect is expected while the direct effect is not significant and the pre-requisite of the significance of the total effect is not required. This model indicates that the independent variable influences the dependent variable only through an intervening factor.

Insert Figure 3 here

Additional analysis

We also assessed the relationship between the time participants spent thinking about their personal topic and change in WMC. In the worry condition, correlational analysis indicated a negative relationship between these variables ($r(26) = -.54$, $p < .01$) suggesting that the time participants spent thinking about their personal topics was associated with smaller improvements in WMC. This relationship was not found in the control condition ($r(28) = .08$, $p = .68$). These two correlation coefficients differed from each other significantly (Fisher's $z = 2.38$, $p < .05$).

Discussion

The purpose of the present study was to investigate the direct influence of active worry on WMC. In keeping with the predictions of the ACT (Eysenck et al., 2007), active worry was expected to reduce processing efficiency and lead to reduced WMC. The results were in line with that prediction. Our mediation model found that levels of active worry mediated the relationship between condition and changes in WMC indicating that worrying interfered with improvements in WMC. Furthermore, the time participants spent thinking about their personal topic was also related to smaller improvements in WMC in the worry condition. These results are among the first to demonstrate a direct effect of active worrying on a measure of WMC and in this sense have direct implications for theories of anxiety and worry (e.g., Eysenck et al., 2007; Berggren & Derakshan, 2013; Hirsch & Mathews, 2012) that attempt to understand the main mechanism by which anxiety related effects impair performance outcome(s). Accordingly, our results showed that worrying likely depletes resources of working memory that are needed for efficient task performance providing the first direct support for one of the main predictions of the ACT (Derakshan & Eysenck, 2009).

In recent research, it has been demonstrated that high levels of trait susceptibility to worry are associated with reduced attentional control in the presence of threat related distractors (Stout et al., 2015; Owens et al., 2015) with other work showing that active worrying can have a detrimental effect on working memory performance in a healthy population (Hayes et al., 2008) as well as in GAD patients (Stefanopoulou et al., 2014). Our results extend these findings by shedding light on a mechanism by which worrying can adversely affect working memory through its influence on WMC. Interestingly, in line with previous work (e.g., Stout et al., 2015) our results showed that higher levels of anxiety were also related to greater detriments on WMC.

Impaired WMC using the CDT in anxiety has also been documented elsewhere (Qi, Chen, Hitchman, Zeng, Ding, Li, & Hu, 2014). In this study, Qi et al. (2014) observed reduced WMC at the neurophysiological level for high anxious participants suggesting disrupted processing efficiency by anxiety. This result was more evident when the task was more difficult and higher WMC was required. The authors explained these results in terms of elevated worry due to a stressful situation (task difficulty) in high anxious individuals.

Understanding the influence of worry on processing efficiency is valuable for educational as well as clinical reasons. An important implication of these results can be found in academic and evaluative conditions where worrying can have serious and severe (deleterious) effects on cognitive performance outcome(s) through its direct depletion of WMC leading to adverse consequences on academic achievement levels that are dependent upon WMC (Owens, Stevenson, Hadwin, & Norgate, 2012). Accordingly, results of the current study show that worrying can harm WMC and in situations such as academic evaluations where WMC resources are needed for task demands it can exert a direct detrimental effect on outcomes. Secondly, excessive worrying is one of the main characteristics of mood and anxiety disorders (Hirsch & Mathews, 2012; Nolen-Hoeksema, 1991). Hence, clarifying the role of worry on processing efficiency and WMC would help to gain greater insight into the cognitive risk factors of onset and maintenance of these disorders. According to recent models of working memory (see Shipstead et al., 2014; Gazzaley & Nobre, 2012), WMC and attentional control are highly inter-linked at a conceptual as well as a measurement level. Given the wealth of accumulating evidence documenting attentional control deficits in anxiety, the investigation that reduced WMC can explain the onset and recurrence of anxiety related symptomatology is imperative to developing clinical models of anxiety that are keen to understand the causal mechanisms behind anxiety related disorders. In this respect, there is an increasing interest in targeting working memory through adaptive cognitive training regimes meant to establish not only plasticity induced changes in cognitive function (Owens et al., 2013) but also training-dependent reductions in anxious symptomatology over time (e.g., Sari, Koster, Pourtois, & Derakshan, 2015). The current findings motivate the targeting of WMC to reduce the effects of worry related thoughts on a wide range of behavioral outcomes.

The present study established that worrying can cause disruptions to WMC. Interestingly, condition did not influence WMC directly but through the levels of state worry and anxiety implying the importance of individual differences in emotional reactivity. This might be related to trait factors like trait anxiety. However, the current study did not investigate the role trait worry/anxiety. In a related manner, given the vast evidence on attentional bias towards negative emotional stimuli being conceived as a well-known vulnerability factor for anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007) active worrying might be related to increased attentional bias towards threat, as well as hypervigilance for threat (see Eysenck, 1992) leading in turn to detriments to performance. To this end, future studies are recommended to examine how worrying can increase attentional bias for threat through reducing WMC. Furthermore, here we found that both state anxiety and worry were related to impairments in working memory. Since worry is described as a cognitive component of anxiety (Mathews, 1990), it is not surprising that increased level of worry led to elevated anxiety and similar results were observed both for worry and anxiety. Given the high correlation between worry and anxiety it is impossible to conclude that the effect observed on WMC is specific only for worry. Thus, although this study was framed in terms of worry capturing attentional resources and impairing working memory storage, other mechanisms could also be at play. For instance, anxiety or heightened arousal may have an influence on working memory as increased anxious arousal was associated with impaired spatial working memory (Shackman, Sarinopoulous, Maxwell, Pizzagalli, Lavric, & Davidson, 2006; Lavric, Rippon & Gray, 2003). Future studies could focus on this distinction in order to understand the unique role of worry on working memory in situations where anxiety and worry are less entangled. Another limitation of the current study was limited sample size. In order to obtain stable confidence intervals in our sample size, the confidence level we used in mediation analyses needed to be re-adjusted.

In conclusion, the current study provides further evidence that worrying can reduce WMC. This suggests a mechanism by which the detrimental effects of anxiety and worry on performance outcome can be explained.

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Acknowledgements

We would like to express our thanks to Gilles Pourtois and Igor Marchetti for their comments on an earlier version of the manuscript.

Table caption

Table 1. Mean VAS scores at pre-manipulation, post-manipulation and at the end of the task for Worry and Control conditions. SDs are reported in parenthesis.

Figure captions

Figure 1. Example of a 4-item condition in a change trial. Participants are instructed to remember the orientations of the rectangles, and respond during the test array to indicate whether a change occurred or not.

Figure 2. Theoretical diagram for indirect, total, and direct effects of condition on change in working memory capacity with either WorryMean, AnxietyMean or STAI-SA as an intervening variable.

Figure 3a. Relationship between the level of worry and the change in WMC in each condition.

Figure 3b. Relationship between the level of anxiety and the change in WMC in each condition.

Figure 3c. Relationship between STAI-SA scores and the change in WMC in each condition.

Footnotes

Footnote 1. **Although bootstrapping is a recommended method that is also robust in smaller sample sizes, in our study the upper-lower bounds of the confidence intervals varied slightly upon repetition of the analyses. Increasing the number of bootstrap samples is one of the ways to overcome this problem (Hayes, 2013). Hence, we used 10000 bias-corrected bootstrap while 5000 is usually an acceptable number. Furthermore, we slightly decreased the confidence interval to 94% from 95%. As the level of confidence decreases, the gap between the upper and lower bound of the confidence interval gets smaller.**

Footnote 2. Mediation analyses with condition as an independent variable, change scores in working memory capacity as a dependent variable and the level of worry as intervening factor in the distractor condition (b = -.0580; boot 94% CI = [-.3724, .1774]) and two-item condition (b = -.1227; boot 94% CI = [-.2860, 0140]) did not lead to significant indirect effects.

Table 1

	Pre-manipulation		Post-manipulation		After the Task	
	Control condition	Worry condition	Control condition	Worry condition	Control condition	Worry condition
Worry Ratings	28 (26)	28 (24)	21 (19)	55 (24)	17 (16)	46 (22)
Relax Ratings	66 (24)	57 (31)	79 (17)	51 (20)	77 (17)	56 (25)
Happy Ratings	71 (18)	70 (19)	82 (14)	59 (23)	80 (17)	60 (24)
Anxiety Ratings	26 (25)	26 (24)	19 (22)	52 (22)	17 (22)	42 (21)

Table 1. Mean VAS scores at pre-manipulation, post-manipulation and at the end of the task for Worry and Control conditions. SDs are reported in parenthesis.
254x190mm (96 x 96 DPI)

Figure 1

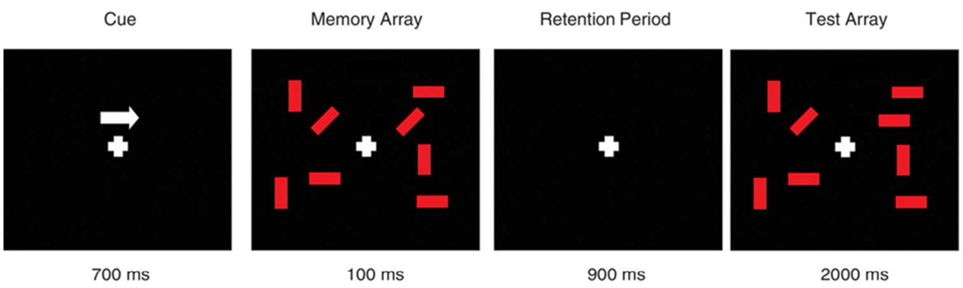

Figure 1. Example of a 4-item condition in a change trial. Participants are instructed to remember the orientations of the rectangles, and respond during the test array to indicate whether a change occurred or not.
254x190mm (96 x 96 DPI)

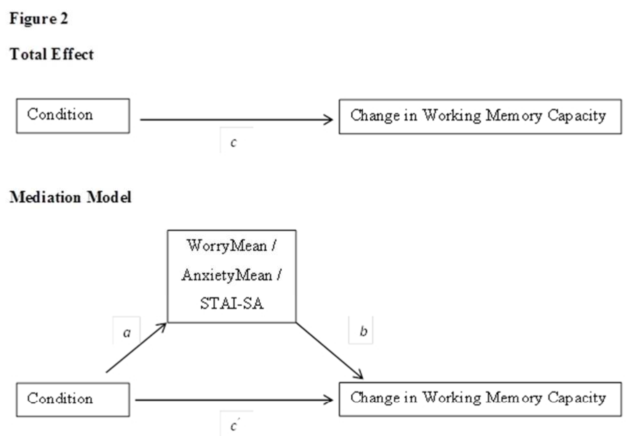

Figure 2. Theoretical diagram for indirect, total, and direct effects of condition on change in working memory capacity with either WorryMean, AnxietyMean or STAI-SA as an intervening variable.
254x190mm (96 x 96 DPI)

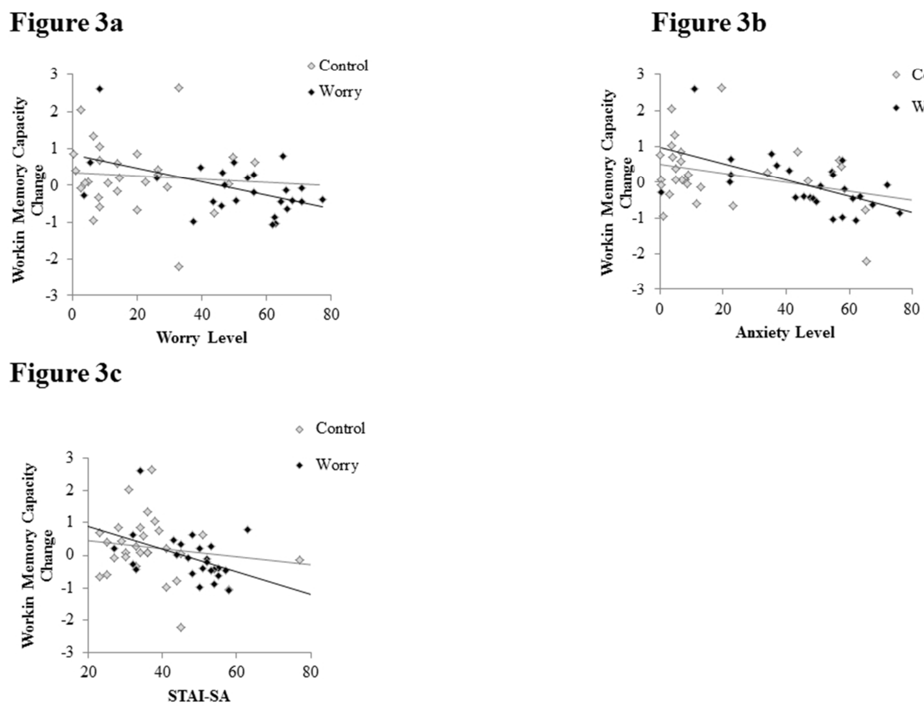

Figure 3a. Relationship between the level of worry and the change in WMC in each condition.\r\nFigure 3b. Relationship between the level of anxiety and the change in WMC in each condition.\r\nFigure 3c. Relationship between STAI-SA scores and the change in WMC in each condition.\r\n
254x190mm (96 x 96 DPI)