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# Clinical Correlates and Cognitive Underpinnings of Uncontrollable Worry

## **Abstract**

Uncontrollable anxious thought characterizes a number of emotional disorders and has been linked to impaired emotional and physical health. The present research aimed to clarify the nature of uncontrollable worry as a clinical and cognitive construct. Chapter 1 evaluated uncontrollability of worry as a diagnostic criterion for generalized anxiety disorder (GAD). This study was conducted in response to the proposed removal of the "uncontrollability of worry" requirement from the diagnostic criteria for GAD in DSM-5. Uncontrollability of worry incrementally predicted an array of clinical severity indicators--including GAD severity, co-occurrence of other mood and anxiety disorders, and treatment utilization--over and above existing GAD criteria, underscoring the importance of uncontrollability of worry to the conceptualization of GAD. In Chapter 2, the Beliefs about Thought Control scale (BATC) was developed to investigate metacognitive beliefs about thought control as a cognitive correlate of--and potential risk factor for--GAD and other disorders characterized by uncontrollable thought. The BATC showed strong convergent and discriminant validity and incrementally predicted trait worry and GAD severity over and above an existing worry-specific measure. Chapter 3 aimed to identify the cognitive underpinnings of attempts to control worry using an experimental approach in which worry was induced in the laboratory. Two components of executive control--working memory and inhibition--were impaired during attempts to control worry, suggesting that these processes may play a role in the worry control process. Collectively, these studies highlight the importance of uncontrollability in defining clinically significant worry, point to cognitive and metacognitive processes that may contribute to the onset or maintenance of uncontrollable worry, and suggest several promising directions for future basic and applied research.

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## **First Advisor**

Ayelet M. Ruscio

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**CLINICAL CORRELATES AND COGNITIVE UNDERPINNINGS OF  
UNCONTROLLABLE WORRY**

Lauren S. Hallion

A DISSERTATION

in

Psychology

Presented to the Faculties of the University of Pennsylvania

in

Partial Fulfillment of the Requirements for the

Degree of Doctor of Philosophy

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Graduate Group Chairperson

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CLINICAL CORRELATES AND COGNITIVE UNDERPINNINGS OF  
UNCONTROLLABLE WORRY

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2014

Lauren Sara Hallion

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The findings from Chapter 3 have been published as:

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## ABSTRACT

### CLINICAL CORRELATES AND COGNITIVE UNDERPINNINGS OF UNCONTROLLABLE WORRY

Lauren S. Hallion

Ayelet Meron Ruscio

Uncontrollable anxious thought characterizes a number of emotional disorders and has been linked to impaired emotional and physical health. The present research aimed to clarify the nature of uncontrollable worry as a clinical and cognitive construct. Chapter 1 evaluated uncontrollability of worry as a diagnostic criterion for generalized anxiety disorder (GAD). This study was conducted in response to the proposed removal of the “uncontrollability of worry” requirement from the diagnostic criteria for GAD in *DSM-5*. Uncontrollability of worry incrementally predicted an array of clinical severity indicators—including GAD severity, co-occurrence of other mood and anxiety disorders, and treatment utilization—over and above existing GAD criteria, underscoring the importance of uncontrollability of worry to the conceptualization of GAD. In Chapter 2, the Beliefs about Thought Control scale (BATC) was developed to investigate metacognitive beliefs about thought control as a cognitive correlate of—and potential risk factor for—GAD and other disorders characterized by uncontrollable thought. The BATC showed strong convergent and discriminant validity and incrementally predicted trait worry and GAD severity over and above an existing worry-specific measure. Chapter 3 aimed to identify the cognitive underpinnings of attempts to control worry using an experimental approach in which worry was induced in the laboratory. Two components of executive control—working memory and inhibition—were impaired

during attempts to control worry, suggesting that these processes may play a role in the worry control process. Collectively, these studies highlight the importance of uncontrollability in defining clinically significant worry, point to cognitive and metacognitive processes that may contribute to the onset or maintenance of uncontrollable worry, and suggest several promising directions for future basic and applied research.

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## CHAPTER 1: GENERAL INTRODUCTION

*Jack and Jill sat down at their desks to write their dissertations.*

*Both thought, “what if it’s no good?” and lost their concentration.*

*Jill soon thought “this is no help,” and refocused her attention.*

*Jack tried, but failed, to stop his worry, and developed hypertension.*

Negative, repetitive thought is a common feature of mood and anxiety disorders. One form of negative repetitive thought, uncontrollable worry, is identified in the *Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition (DSM-IV*; American Psychiatric Association, 1994), as the core feature of generalized anxiety disorder (GAD), while rumination, the tendency to dwell on past losses, mistakes, or failures, is often reported in major depressive disorder (MDD; Nolen-Hoeksema, 1991). Obsessive-compulsive disorder (OCD) and post-traumatic stress disorder (PTSD) are characterized by unwanted and highly distressing intrusive thoughts and memories, respectively (American Psychiatric Association, 1994), while patients with social anxiety disorder often engage in post-event rumination, a repetitive mental reviewing of social encounters with a particular emphasis on negative self-evaluations (Kashdan & Roberts, 2007).

Of the many forms of repetitive thought, worry may be the most ubiquitous. Worry has been defined as “a chain of thoughts and images, negatively affect laden and relatively uncontrollable; it represents an attempt to engage in mental problem-solving on an issue whose outcome is uncertain but contains the possibility of one or more negative outcomes” (Borkovec, Robinson, Pruzinsky, & DePree, 1983, p. 9). In addition to being

the central feature of GAD, worry is elevated in outpatients with specific phobia, social phobia, panic disorder, MDD, OCD, and PTSD, relative to healthy individuals (Chelminski & Zimmerman, 2003). In daily life, individuals with GAD and MDD experience comparably frequent and severe worry, with rumination less frequently reported (Ruscio, Hallion, Gentes, Jones, Coleman, & Swendsen, under review). Furthermore, experimental and prospective studies have linked elevated worry to an array of negative outcomes, including increased anxiety and depression (Calmes & Roberts, 2007; Hong, 2007; McLaughlin, Borkovec, & Sibrava, 2007), slower and more painful recovery from surgery (Broadbent, Petrie, Alley, & Booth, 2003) and illness (Fortune et al., 2003), poorer immune functioning (Seegerstrom, Glover, Craske, & Fahey, 1999), increased risk of coronary heart disease (Kubzansky et al., 1997), lower cardiac vagal control (Thayer et al., 1996), and general somatic complaints (Brosschot & van der Doef, 2006; see Watkins, 2008 for a comprehensive review). Finally, many individuals continue to suffer from chronic worry even after receiving state-of-the-art treatment (Mitte, 2005). Taken together, these findings underscore the need for research that more clearly articulates the nature of uncontrollable worry in order to inform the development of more effective interventions.

Importantly, contemporary definitions of worry include the assertion that worry is “relatively uncontrollable.” Building on this assertion is the argument that “uncontrollability (or the difficulty of dismissal) seems to be the most central feature of worry” (Borkovec, Shadick, & Hopkins, 1991, p. 31). Despite the central place of uncontrollability in characterizations of worry, however, anecdotal, clinical, and empirical evidence suggest that worry is more uncontrollable for some people than

others. Questionnaire studies with nonclinical samples suggests that the vast majority of individuals attempt to stop their worry at least some of the time (Tallis, Davey, & Capuzzo, 1994). Whereas low worriers (i.e., individuals with low scores on a popular measure of tendency to worry) find it “slightly difficult” to stop worrying, high worriers report that stopping worry is “quite difficult.” High worriers also endorse a more frequent return of worry after initial successful termination.

The requirement that worry be uncontrollable was added to the diagnostic criteria for GAD in response to research showing that uncontrollability of worry reliably distinguished individuals with and without *DSM-III-R* GAD (Abel & Borkovec, 1995; Borkovec, 1994; Brown, Barlow, & Liebowitz, 1994; Craske, Rapee, Jackel, & Barlow, 1989). Perceptions of uncontrollability over worry also distinguish individuals with *DSM-IV* GAD from healthy controls (Cartwright-Hatton & Wells, 1997), patients with social anxiety disorder (Hoyer, Becker, & Roth, 2001), and high trait worriers without GAD (Ruscio, 2002; Ruscio & Borkovec, 2004). In one study (Ruscio & Borkovec, 2004), individuals with GAD reported less control over worry compared to trait worry-matched counterparts without GAD, who in turn reported less control than nonanxious participants. Notably, on a behavioral task, high worriers with and without GAD experienced generally comparable levels of difficulty inhibiting worried thoughts, suggesting that GAD worriers may have overestimated (or non-GAD worriers underestimated) the uncontrollability of their worry.

Taken together, these findings suggest that experiences and appraisals of thoughts as uncontrollable are an important component of severe worry in general, and of GAD in particular. These findings are also consistent with theoretical models that suggest an

etiological role for perceptions of uncontrollability in the development and maintenance of GAD. One such model, the metacognitive model of GAD (Wells, 1995; Wells & Carter, 1999), argues that excessive worry about external events (e.g., finances; world affairs) and non-cognitive internal events (e.g., one's physical health) is not sufficient for the development of GAD. Rather, individuals must hold negative beliefs about their worry—in particular the belief that worry is uncontrollable and dangerous—for GAD to develop. Because worriers often espouse positive beliefs about worry (e.g., “worry helps me cope;” Wells & Cartwright-Hatton, 2004), worriers often initiate the worry process intentionally. However, the model argues that individuals who also (or instead) view worry as uncontrollable and dangerous will begin to experience meta-worry (or “worry about worry”) as worry levels rise. This meta-worry is proposed to elicit a pattern of reactions (e.g., behavioral avoidance and redoubled thought control efforts) that elicit and exacerbate GAD symptoms, which in turn feed the belief that worry is uncontrollable and dangerous.

Although it has become increasingly clear that actual or perceived difficulties with cognitive control are important to GAD and numerous other emotional disorders, surprisingly little is known about why some people struggle to dismiss unwanted thoughts whereas others seem to dismiss these thoughts with relative ease. Until quite recently, research on cognitive processes in psychopathology has been conducted mainly in the context of specific disorders (Beck, 1991) and in relative isolation from the vast and growing basic literature on attention and cognitive control. Efforts to integrate these diverse literatures may deepen our understanding of the basic cognitive and metacognitive mechanisms underlying uncontrollable anxious thought and suggest new

targets for intervention. These efforts are consistent with recent calls to link clinical and basic research and to identify and investigate cognitive processes that may cut across traditional diagnostic categories and help explain their co-occurrence (Harvey, Watkins, Mansell, & Shafran, 2004; Sainslow et al., 2010). More broadly, efforts to integrate disparate research traditions (clinical, cognitive, psychometric) and methodological approaches (self-report, interview, experimental) have the potential to provide converging evidence to support or refute leading conceptualizations of repetitive thought.

This dissertation addresses several questions related to worry and its control. Chapter 1 reports an investigation of the incremental validity of the “uncontrollability of worry” diagnostic criterion for GAD. This paper was written in response to suggestions that uncontrollability of worry should be removed from the definition of GAD due to its high correlation with another diagnostic criterion: the requirement that worry be excessive (Andrews et al., 2010). Chapter 2 investigated the relationship of beliefs about thoughts—namely, the belief that thoughts can and should be controlled—to trait worry and other anxiety and mood symptoms. Although beliefs about thought control have been suggested to serve as etiological and maintaining factors for several disorders, including GAD and OCD (Frost & Steketee, 2002; Purdon, 1999; Wells, 1995; Wells & Carter, 1999), existing measures are largely disorder- and content-specific, precluding tests of transdiagnostic hypotheses. A new measure, the Beliefs About Thought Control scale (BATC), was therefore developed to facilitate tests of these transdiagnostic accounts. Chapter 3 used an experimental approach to identify the cognitive control mechanisms that are engaged by attempts to control worry. The identification of such mechanisms is an important prerequisite for the development of interventions to target,

and possibly ameliorate, disruptions in cognitive functioning that underlie repetitive thought.

The findings described in this dissertation highlight several promising directions for future research. Although the present research focused primarily on worry and its control, negative repetitive thought characterizes a number of emotional disorders. As such, parallel questions could be asked for other disorders characterized by uncontrollable thought. If beliefs about thought control incrementally predict GAD symptoms over and above existing content-specific measures, as was hypothesized in Chapter 2, might such beliefs also incrementally predict symptoms of OCD, PTSD, or depression? If prospective and experimental research identifies these beliefs as causally related to disorder symptoms, it may support the development of early interventions designed to reduce these beliefs before disorders emerge. Similarly, if attempts to control worry engage specific cognitive control mechanisms, as was hypothesized in Chapter 3, might similar processes be engaged during attempts to control rumination, obsessional thoughts, or intrusive memories? If these mechanisms converge, it may support the incorporation of cognitive control training into existing transdiagnostic treatments for these disorders.

Future research might also aim to articulate the neural bases of control over worry. Researchers are just beginning to investigate the neural correlates of negative, repetitive thought. Such investigations have focused on worry and its control (Paulesu et al., 2010) as well as on related constructs such as rumination (Cooney, Joorman, Eugene, Dennis, & Gotlib, 2010), thought suppression (Wyland, Kelley, Macrae, Gordon, & Heatherton), and cognitive strategies implicated in emotion regulation (Ochsner, Bunge,



Gross, & Gabrieli, 2002). Early results have suggested a role for many of the same regions (i.e., dorsolateral and dorsal medial prefrontal cortex, anterior cingulate gyrus) in these processes, suggesting that on a neural level, these diverse processes may be more similar than different. These studies also hint at potential biological mechanisms of uncontrollable worry. For example, one study (Paulesu et al., 2010) found that a worry induction produced similar patterns of activation in participants with GAD and healthy controls. However, only participants with GAD showed sustained activation of these areas during resting periods that followed the inductions, suggesting that impaired inhibition of these circuits may represent one biological mechanism of uncontrollable worry. Notably, the regions identified in studies of worry and related processes share considerable overlap with regions activated by “cold” cognitive control tasks (e.g., Botvinick, Nystrom, Fissell, Carter, & Cohen, 1999; Owen, McMillan, Laird, & Bullmore, 2005). This overlap strengthens the argument for applying methods and measures of cognitive and other sciences to clinical phenomena. In turn, it suggests that the study of uncontrollable worry and other forms of pathological cognitive dyscontrol may enhance basic understanding of human cognition.

CHAPTER 2: SHOULD UNCONTROLLABLE WORRY BE REMOVED FROM THE  
DEFINITION OF GAD? A TEST OF INCREMENTAL VALIDITY

**Abstract**

In its current instantiation in *DSM-IV*, a diagnosis of generalized anxiety disorder (GAD) requires the presence of excessive and uncontrollable worry. It has been proposed that the uncontrollability criterion be removed from future editions of the *DSM*, primarily on the basis of empirical and conceptual overlap between excessiveness and uncontrollability and a relative lack of research on uncontrollability. However, no research has directly investigated the incremental validity of the uncontrollability criterion—that is, the extent to which uncontrollability predicts important clinical information over and above excessiveness. This question was examined in a community sample of 126 adults diagnosed with GAD. After controlling for excessiveness, uncontrollability explained a significant proportion of additional variance in a variety of relevant clinical measures, including GAD severity, clinician-rated anxiety, number and severity of comorbid disorders, and use of psychotropic medication and psychotherapy. The results remained statistically significant even when other features of GAD were controlled. By contrast, excessiveness did not significantly predict any clinical measure over and above uncontrollability. These findings suggest that uncontrollability contributes to the validity of the GAD diagnosis and should be retained as a core feature of pathological worry.

Over the last several decades, generalized anxiety disorder (GAD) has evolved from a “wastebasket” diagnosis to a robust and clinically meaningful construct that can be diagnosed as reliably as most other Axis I disorders (Brown, DiNardo, Lehman, & Campbell, 2001). In its current instantiation in *DSM-IV* (American Psychiatric Association, 1994), GAD is centrally defined by the presence of excessive and uncontrollable worry that persists for six months or longer. To warrant a diagnosis, individuals must also experience at least three of six associated symptoms (one associated symptom in children) and clinically significant distress or impairment. In the run-up to *DSM-5*, several revisions to these criteria were proposed. Arguably the most controversial of these was the proposed removal of the “uncontrollability” criterion (Criterion B), which requires that the individual finds the worry difficult to control. Although GAD will remain largely unchanged in *DSM-5*, the suggestion that this criterion be eliminated has highlighted questions about the role that uncontrollability should play in defining pathological worry.

The uncontrollability criterion was added in *DSM-IV* as part of a larger effort to refine the definition of GAD and improve the reliability and discriminant validity of the diagnosis (Brown, Barlow, & Liebowitz, 1994). The recommendation to include this criterion was based primarily on research suggesting that “uncontrollability (or the difficulty of dismissal) seems to be the most central feature of worry” (Borkovec, Shadick, & Hopkins, 1991, p. 31) and that the ability to control worry distinguishes individuals high and low in trait worry (Borkovec, Robinson, Pruzinsky, & DePree, 1983) and individuals with and without *DSM-III-R* GAD (Abel & Borkovec, 1995; Borkovec, 1994; Craske, Rapee, Jackel, & Barlow, 1989). The requirement that worry be

perceived as difficult to control was also considered an improvement over the *DSM-III-R* requirement that worries be unrealistic, which was discarded because it was unreliable, subjective, and difficult to operationalize (Borkovec et al., 1991), concerns that have since been raised about the excessiveness requirement as well (Ruscio et al., 2005).

Since the inclusion of the uncontrollability criterion in *DSM-IV*, empirical and theoretical interest in control over worry—and in cognitive control more broadly—has grown. Difficulty controlling anxious thoughts has been linked to heightened anxiety and depression (Peterson, Klein, Donnelly, & Renk, 2009) and has been proposed to play a key role in the onset and maintenance of several anxiety disorders (e.g., Rachman, 1997; Wells, 1995). These findings are consistent with leading theoretical accounts that implicate perceptions of uncontrollability, broadly construed, in the etiology of anxiety disorders (Mineka & Zinbarg, 2006). Negative beliefs about control over worry have been found to be especially relevant for GAD, discriminating individuals with GAD not only from healthy controls (Cartwright-Hatton & Wells, 1997; Hoyer, Becker, & Roth, 2001) but from high worriers without GAD (Hoyer, Becker, & Margraf, 2002; Ruscio & Borkovec, 2004) and from individuals with other anxiety disorders (Cartwright-Hatton & Wells, 1997; Hoyer et al., 2001, 2002) and major depressive disorder (MDD; Barahmand, 2009).

Despite growing evidence for uncontrollability as an important feature of anxiety and GAD, some researchers have questioned its necessity as a diagnostic criterion, citing the conceptual similarity and strong association of uncontrollability with excessiveness (e.g.,  $r = .91$ ; Brown et al., 2001) as indications of redundancy (Andrews et al., 2010). This concern has been underscored by research demonstrating that removing the

uncontrollability criterion while retaining the excessiveness criterion would have a small impact on the lifetime prevalence and identified cases of GAD (Andrews & Hobbs, 2010; Beesdo-Baum et al., 2011). If excessiveness and uncontrollability are redundant, discarding one of these criteria could result in improved diagnostic efficiency without compromising validity and clinical utility. Indeed, the recommendation to remove uncontrollability from *DSM-5* was based mainly on the premise that this criterion does not contribute unique clinical information to the GAD diagnosis over and above excessiveness. To date, however, no research has tested this assumption directly. This important gap should be addressed before the uncontrollability criterion is discarded.

To that end, the present study evaluated the incremental validity of the uncontrollability criterion. Specifically, we tested the hypothesis that uncontrollability of worry accounts for unique variance in important concurrently-assessed clinical measures among GAD cases, over and above information contributed by excessiveness of worry. Whereas a demonstration of incremental validity would suggest that uncontrollability should be retained in the definition of GAD, evidence of redundancy with excessiveness would argue against the need for both criteria.

## **Method**

### **Participants**

Participants were 126 adults with *DSM-IV* GAD recruited from the Philadelphia community ( $n = 112$ ) and from a private northeastern university ( $n = 14$ ; see Table 1). Participants were recruited via electronic and posted advertisements for a research study on anxiety and depression and received \$10 per hour for their time. GAD was the principal (most severe) diagnosis in two-thirds ( $n = 83$ ) of these cases. The remainder

had principal MDD and were included to enhance ecological validity, given the frequent comorbidity of GAD with MDD (Kessler et al., 2008). Participants were excluded if they had a principal diagnosis other than GAD or MDD, were acutely psychotic or suicidal, or had a current substance use disorder.

To evaluate the reliability of these diagnoses, an independent clinical interviewer rated the recorded interviews of 42 cases, including 25 GAD cases randomly selected from the current sample (20%) plus an additional 17 cases without GAD randomly selected from the larger study in which these measures were administered. Interrater agreement was high for the presence of *DSM-IV* GAD ( $\kappa = 1.00$ ). In the subsample with GAD, interrater agreement was acceptable for GAD and MDD clinical severity (ICC = 0.73 and 0.90, respectively) and for the presence of comorbid MDD ( $\kappa = 0.92$ ).

## **Measures**

### **Predictor variables.**

*Uncontrollability and excessiveness.* Uncontrollability and excessiveness were assessed using the GAD module of the Anxiety Disorders Interview Schedule for *DSM-IV* (ADIS-IV; Brown, DiNardo, & Barlow, 1994). In accordance with ADIS-IV administration standards, interviewers rated the uncontrollability of worry reported by participants for each of eight life domains (minor matters, work/school, family, finances, social/interpersonal, health of self, health of significant others, community/world affairs) on a scale of 0 (worry is never difficult to control) to 8 (worry is extremely difficult to control). Interviewers separately rated the excessiveness of worry for the same eight domains on a scale of 0 (no worry/tension) to 8 (constantly worried/extreme tension). Interrater agreement was good for each of the eight domains of uncontrollability (mean

ICC = .84; range = .70 – .96) and excessiveness (mean ICC = .87; range = .80 – .94). Ratings were averaged across domains to create a global uncontrollability score and a global excessiveness score. These uncontrollability and excessiveness composite scores were comparable in terms of range (4.75 and 4.38, respectively) and internal consistency (Cronbach's  $\alpha$  = .62 and .60, respectively).

***Other features of GAD.*** Diagnostic features of GAD other than worry were assessed using the ADIS-IV. A Criterion C composite was created by averaging the severity ratings (0 – 8) for the six associated symptoms of GAD. A clinical significance composite was created by averaging self-reported distress and interference attributed to GAD symptoms (0 – 8). Interrater agreement was good for these composites (ICC = 0.92 and 0.80, respectively).

#### **Anxiety-related measures.**

***Global anxiety severity.*** Interviewers rated participants' anxiety symptoms on the 14-item Hamilton Anxiety Rating Scale (HAM-A; Hamilton, 1959), a widely used clinician-administered scale (Shear et al., 2001).

***GAD and worry severity.*** Interviewers rated GAD clinical severity (0 – 8) for all participants. Additionally, participants estimated the percent of an average day that they spent worrying (0 – 100%) on the ADIS-IV, and self-reported their typical (trait) levels of worry on the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, &

Borkovec, 1990). These measures were used as measures of the day-to-day impact of GAD on participants' lives.<sup>1</sup>

### **Comorbidity-related measures.**

**Comorbid disorders.** The number and severity of comorbid mental disorders were assessed using the ADIS-IV. We focused on anxiety disorders (panic disorder with and without agoraphobia, social anxiety disorder, obsessive-compulsive disorder, post-traumatic stress disorder, acute stress disorder, specific phobia) and mood disorders (MDD, dysthymic disorder, bipolar disorders) given their common co-occurrence with GAD (Ruscio et al., 2005). Each disorder was assessed for diagnostic status (present/absent) and assigned a clinical severity rating (0 – 8). Number of comorbid disorders was determined by summing the number of disorders other than GAD for which *DSM-IV* diagnostic criteria were met. Severity of comorbid disorders was determined by averaging the clinical severity of all disorders other than GAD for which diagnostic criteria were met.

**Global depression severity.** Interviewers rated participants' depression symptoms on the 17-item Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960), a widely used global measure of depression severity (López-Pina, Sánchez-Meca, & Rosa-Alcázar, 2009).

### **Treatment-related measures.**

---

<sup>1</sup> We considered creating a single latent or composite outcome variable for each category (e.g., one "anxiety related measures" outcome variable). However, there was considerable variability in the association strengths between the variables within each category (e.g.,  $r = 0.06-0.50$  for anxiety-related measures). Consequently, we decided that each variable was most accurately conceptualized as a distinct outcome.



**Treatment history.** Dichotomous variables representing current use of psychotropic medication, current use of psychotherapy, and lifetime history of psychiatric hospitalization were drawn from the Medical History module of the ADIS-IV.

### **Procedure**

Interviews were administered by Master's- and Bachelor's-level interviewers who received extensive training and demonstrated high interrater reliability with the supervising licensed psychologist. Final diagnostic status and clinical severity ratings were determined in weekly team consensus meetings. Interviewers and supervisors were blind to study hypotheses.

### **Statistical Analyses**

Hierarchical multiple and logistic regression analyses were performed to examine the incremental validity of uncontrollability over and above excessiveness. In each analysis, excessiveness was entered on the first step and uncontrollability was entered on the second step. Additionally, outliers that scored  $\geq 2.5 SD$  above or below the mean for that variable or which exerted an unduly large influence on the model (defined using Cook's distance) were removed, resulting in the exclusion of 0 to 3 data points (less than 3% of available data) per analysis. Three clinical measures (number and severity of comorbid disorders and MDD severity among depressed participants) had non-normal distributions and consequently were  $\log_{10}$  transformed prior to analysis. Variance inflation factors (VIF) were below 4, suggesting that multicollinearity was not a problem in these analyses.

## **Results**

Descriptive statistics for all measures appear in Table 2. As expected, excessiveness and uncontrollability were highly correlated ( $r = .83$ ).

Despite this correlation, uncontrollability predicted anxiety-related measures over and above excessiveness (see Table 3). Effect sizes were small to moderate, with uncontrollability explaining an additional 2 – 11% of the variance over and above excessiveness. These effects were statistically significant for measures of GAD and worry (GAD clinical severity, percent of the day spent worrying, trait worry) and marginally significant for global anxiety severity. Notably, excessiveness was no longer a significant predictor of any measure once uncontrollability was entered into the models.

Uncontrollability also significantly predicted both the number and severity of comorbid emotional disorders over and above excessiveness, explaining an additional 4% of the variance in each analysis (see Table 4). Excessiveness no longer predicted either measure once uncontrollability was included in the model.

Given the particularly close relationship of GAD to MDD, we performed additional analyses focusing specifically on depression-related measures. Uncontrollability incrementally predicted greater global depression severity in this GAD sample, explaining an additional 4% of the variance and rendering excessiveness nonsignificant (see Table 5). Uncontrollability did not predict the presence of comorbid MDD (see Table 6), but marginally predicted the severity of the current depressive episode among participants diagnosed with MDD (see Table 5).

Finally, uncontrollability was incrementally associated with treatment-seeking (see Table 7). The pattern differed for pharmacotherapy versus psychotherapy. Higher uncontrollability was associated with elevated odds of psychotropic medication use (odds

ratio [OR] = 2.52) but with reduced odds of psychotherapy use (OR = 0.50). Once uncontrollability was included in the model, excessiveness was no longer a significant predictor of psychotherapy, but became a significant predictor of medication use. Lastly, higher uncontrollability more than doubled the odds of past psychiatric hospitalization (OR = 2.95).

### **Sensitivity Analyses**

Sensitivity analyses were performed to examine whether the incremental value of uncontrollability held even when controlling for additional features of GAD, including the associated symptoms (Criterion C) and clinical significance (distress and interference) criteria, along with excessiveness. In analyses controlling for all of these features simultaneously, uncontrollability remained a significant predictor of GAD severity (explaining an additional 2% of the variance), percent of the day spent worrying (10%), and trait worry (4%), but was no longer a significant predictor of global anxiety severity (1%). Uncontrollability remained a significant predictor of the number and severity of comorbid disorders (3% in each analysis) and was a marginally significant predictor of global depression severity (2%) in the total sample and depressive episode severity (4%) in the subsample with comorbid MDD. Uncontrollability continued to be positively associated with pharmacotherapy (OR = 2.43) and negatively associated with psychotherapy (OR = 0.47) and was marginally elevated among those with a history of psychiatric hospitalization (OR = 2.29).

### **Discussion**

The present findings should be interpreted in light of several limitations. First, our sample was restricted to individuals diagnosed with GAD. This precluded a test of

the utility of uncontrollability for identifying cases of GAD. Additionally, different results might have been obtained from a sample in which subclinical symptoms were represented. Nevertheless, the predictive power of uncontrollability among these clinically significant cases, observed in spite of the restricted range of uncontrollability scores, argues for the clinical relevance of this criterion. A second limitation was the adult-only sample. Because of their lower metacognitive awareness, children may have difficulty articulating the extent to which their worry is uncontrollable or may not attempt to control their worry (Beesdo-Baum et al., 2011). The generalizability of the present findings to children remains to be determined. Third, we studied clinical measures related to disorder severity and treatment-seeking, with a particular focus on measures of anxiety and depression. Although these measures are well-suited for studying the validity of GAD, other important variables such as illness course and treatment outcome were not represented and await future investigation.

With these limitations in mind, our findings challenge the assumption that uncontrollability contributes little clinical information beyond that provided by excessiveness. After controlling for excessiveness, uncontrollability incrementally predicted a wide range of important clinical measures, including measures specific to GAD and more general measures pertaining to clinical severity, comorbidity, and treatment-seeking. In the majority of analyses, excessiveness was no longer a significant predictor after uncontrollability entered the model. These results remained significant or marginally significant for all but one measure in conservative sensitivity analyses wherein other features of GAD were also controlled. There were no analyses in which excessiveness was a stronger predictor than uncontrollability.

Whether the incremental value of uncontrollability demonstrated by these findings is sufficient to retain this criterion in the GAD diagnosis is a matter of judgment. The relatively small effects observed here are consistent with previous research reporting substantial overlap between excessiveness and uncontrollability (Andrews & Hobbs, 2010). However, the present findings also suggest that excluding the criterion may result in a less valid and clinically informative diagnosis. For GAD, whose diagnostic validity has long been a significant concern, this risk should not be taken lightly.

Removing the uncontrollability criterion may also lead to a missed opportunity to link work on GAD to the exciting and rapidly growing cognitive control literature. There is increasing recognition of the important role played by cognitive dyscontrol in psychopathology in general and in GAD in particular. Impaired cognitive control has been linked to higher trait worry (Crowe, Matthews, & Walkenhorst, 2007), difficulty dismissing unwanted thoughts (Brewin & Smart, 2005), and poorer treatment outcome in older adults receiving cognitive-behavioral therapy for GAD (Mohlman & Gorman, 2005). Continued research into the cognitive processes that underlie normal control over thoughts, and how these processes may be disrupted in individuals with GAD, has the potential to advance understanding of this critical yet poorly understood component of anxiety. Such research may, in turn, help lead to the development of novel treatments for uncontrollable anxious thought—a possibility especially important for GAD, which has the lowest treatment success rate of all anxiety disorders (Siev & Chambless, 2007).

The association between uncontrollability and treatment-seeking described here highlights the value of continued research into uncontrollability. We found that individuals reporting higher uncontrollability generally were more severe clinical cases.

However, rather than exhibiting an undifferentiated pattern of negative outcomes, these individuals reported less use of psychotherapy and more use of pharmacotherapy than their counterparts with lower levels of uncontrollability. While several explanations may account for this finding, one possibility is that persons who perceive worry as far outside their control may feel less able to reduce worry themselves by applying strategies learned in psychotherapy and consequently may seek medication treatment instead. Although preliminary, our treatment-related findings suggest that additional research into uncontrollability and related metacognitive phenomena may help advance understanding of the factors that influence treatment utilization in GAD.

In light of these considerations, it may be asked whether excessiveness, rather than uncontrollability, should be discarded if the overlap between them is judged too high to retain both criteria in the definition of GAD. Our results hint that this may be the more defensible choice, as we did not find evidence for the incremental validity of excessiveness over uncontrollability for any of the clinical measures considered here. Other shortcomings of the excessiveness criterion have been noted previously, including its definitional ambiguity, its negative impact on diagnostic reliability, and its exclusion of milder but still clinically significant cases from the GAD diagnosis (see Ruscio et al., 2005, for a review). Indeed, the recommendation to retain the excessiveness criterion rather than the uncontrollability criterion seems to have been based more on the limited number of studies that have examined uncontrollability than on the strength of the evidence for excessiveness (Andrews et al., 2010). Nevertheless, given the paucity of research available for excessiveness as well as uncontrollability, it may be premature to recommend the removal of either criterion. Future research investigating the relationship

of these criteria to important variables not investigated here (e.g., clinical course, treatment response, family history of GAD), in children as well as adults, will aid in determining whether uncontrollability, excessiveness, or both should remain in future iterations of the *DSM*. Until this research is conducted, however, we believe the present findings warrant further consideration of uncontrollability as an important but neglected feature of GAD and, perhaps, of pathological worry more generally.

Table 1

*Sample Characteristics*

Variable	%
Sex (% female)	64
Ethnicity	
Caucasian	67
African-American	15
Asian/Asian-American	9
Other/Unspecified	10
Level of education	
High school or less	14
Some college	31
Completed college	43
Advanced degree	13
Marital status	
Single/Never married	68
Married/Cohabiting	25
Divorced/Separated/Widowed	7
Occupational status	
Employed	51
Unemployed	33
Student	17



Age: *M (SD)* 31.93 (11.70)

Table 2

*Descriptive Statistics for Clinical Measures*

Variable	<i>M</i>	<i>SD</i>	Min-Max	%
Uncontrollability of worry	4.64	1.10	2.25-7.00	
Excessiveness of worry	5.07	0.96	2.75-7.13	
Anxiety-related measures				
Percent of day spent worrying	62.44	20.93	6-100	---
GAD clinical severity	5.26	0.76	4-7	---
Global anxiety severity (HAM-A total score)	16.21	5.94	0-31	---
Trait worry (PSWQ total score)	69.22	6.47	45-80	
Comorbidity-related measures				
Number of comorbid disorders	2.21	1.67	0-7	---
Severity of comorbid disorders	4.09	1.70	0-6	---
Global depression severity (HAM-D total score)	15.42	5.31	1-28	---
Comorbid MDD diagnosis	---	---	---	60
MDD severity among depressed participants	5.23	0.68	4-6.5	---
Treatment-related measures				

Currently using psychoactive medication	---	---	---	25
Currently using psychotherapy	---	---	---	25
Previous psychiatric hospitalization	---	---	---	19

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*Note.* Unless otherwise specified, measures were assessed using the Anxiety Disorders Interview Schedule. GAD = generalized anxiety disorder; HAM-A = Hamilton Anxiety Rating Scale; PSWQ = Penn State Worry Questionnaire; HAM-D = Hamilton Rating Scale for Depression; MDD = major depressive disorder.

Table 3

*Incremental Validity of Uncontrollability for Predicting Anxiety-Related Measures*

Model and predictor variables	<i>B</i>	<i>SE (B)</i>	95% <i>CI</i>	$\beta$	$R^2$	$\Delta R^2$
Percent of the day spent worrying						
Model 1					.13	.13***
Excessiveness	7.72***	1.86	4.05-11.39	.35		
Model 2					.24	.11***
Excessiveness	-3.37	3.14	-9.58-2.83	-.15		
Uncontrollability	11.61***	2.73	6.20-17.01	.61		
GAD clinical severity						
Model 1					.26	.26***
Excessiveness	0.41***	0.06	0.28-0.53	.52		
Model 2					.31	.05**
Excessiveness	0.18 <sup>†</sup>	0.11	-0.04-0.39	.23		
Uncontrollability	0.25*	0.09	0.06-0.43	.35		
Global anxiety severity (HAM-A)						
Model 1					.11	.11***
Excessiveness	1.92***	0.50	0.93-2.92	.33		
Model 2					.13	.02 <sup>†</sup>
Excessiveness	0.46	0.95	-1.42-2.34	.08		
Uncontrollability	1.51 <sup>†</sup>	0.84	-0.14-3.16	.29		
Trait worry (PSWQ)						
Model 1					.06	.06**
Excessiveness	1.64**	0.62	0.73-3.30	.24		
Model 2					.11	.05*

Excessiveness	-0.46	1.07	-2.25-2.34	-.07
Uncontrollability	2.23*	0.94	0.07-4.10	.38

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*Note.* Unless otherwise specified, measures were assessed using the Anxiety Disorders Interview Schedule. GAD = generalized anxiety disorder; HAM-A = Hamilton Anxiety Rating Scale; PSWQ = Penn State Worry Questionnaire.

† =  $p < .10$ . \* =  $p < .05$ . \*\* =  $p < .01$ . \*\*\* =  $p < .001$ .

Table 4

*Incremental Validity of Uncontrollability for Predicting the Number and Severity of Comorbid Emotional Disorders*

Model and predictor variables	<i>B</i>	<i>SE (B)</i>	95% <i>CI</i>	$\beta$	$R^2$	$\Delta R^2$
Number of comorbid disorders						
Model 1					.14	.14***
Excessiveness	0.09***	.02	0.05-0.14	.37		
Model 2					.18	.04*
Excessiveness	0.01	0.04	-0.06-0.91	.05		
Uncontrollability	0.08*	0.03	0.01-0.15	.37		
Severity of comorbid disorders						
Model 1					.01	.01
Excessiveness	0.004	0.01	-0.01-0.01	.07		
Model 2					.04	.04*
Excessiveness	-0.01	0.01	-0.03-0.01	-.25		
Uncontrollability	0.02*	0.01	0.001-0.04	.37		

*Note.* Measures were assessed using the Anxiety Disorders Interview Schedule.

\* =  $p < .05$ . \*\*\* =  $p < .001$ .

Table 5

*Incremental Validity of Uncontrollability for Predicting Depression Severity*

Model and predictor variables	<i>B</i>	<i>SE (B)</i>	95% <i>CI</i>	$\beta$	$R^2$	$\Delta R^2$
Global depression severity (HAM-D)						
Model 1					.06	.06**
Excessiveness	1.27**	0.47	0.34-2.20	.24		
Model 2					.09	.04*
Excessiveness	-0.30	0.84	-1.95-1.35	-.06		
Uncontrollability	1.64*	0.73	0.20-3.09	.35		
Depressive episode severity						
Model 1					.03	.03
Excessiveness	0.11	0.01	-0.003-0.03	.18		
Model 2					.08	.04 <sup>†</sup>
Excessiveness	-0.10	0.14	-0.04-0.02	-.16		
Uncontrollability	0.02 <sup>†</sup>	0.01	-0.002-0.05	.40		

*Note.* Unless otherwise specified, measures were assessed using the Anxiety Disorders Interview Schedule. HAM-D = Hamilton Rating Scale for Depression.

<sup>†</sup> =  $p < .10$ . \* =  $p < .05$ . \*\* =  $p < .01$ .

Table 6

*Incremental Validity of Uncontrollability for Predicting the Presence of Comorbid MDD*

	<i>B</i>	<i>SE (B)</i>	<i>Wald's <math>\chi^2</math></i>	<i>OR</i>	<i>95% CI</i>
Block 1					
Excessiveness	0.39*	.18	4.55	1.48	0.94-2.02
Constant	0.32	.20	2.75	---	
Block 2					
Excessiveness	0.03	.34	0.01	1.03	0.52-2.01
Uncontrollability	0.32	.30	1.10	1.37	0.76-2.39
Constant	0.40*	.19	4.64	---	

*Note.* Measures were assessed using the Anxiety Disorders Interview Schedule. OR = odds ratio; MDD = major depressive disorder.

\* =  $p < .05$ .

Table 7

*Incremental Validity of Uncontrollability for Predicting Treatment-Related Measures*

Model	<i>B</i>	<i>SE (B)</i>	<i>Wald's <math>\chi^2</math></i>	OR	95% <i>CI</i>
Current use of psychotropic medication					
Block 1					
Excessiveness	-0.27	.23	1.46	0.76	0.49-1.18
Constant	-1.20***	.22	30.73	---	
Block 2					
Excessiveness	-1.17*	.48	5.96	0.31	0.12-0.79
Uncontrollability	0.92*	.43	4.62	2.52	1.08-5.83
Constant	-1.23***	.23	30.98	---	
Current use of psychotherapy					
Block 1					
Excessiveness	-0.46*	.23	4.12	0.63	0.40-0.98
Constant	-1.20***	.22	30.37	---	
Block 2					
Excessiveness	0.16	.38	0.16	1.17	0.55-2.48
Uncontrollability	-0.69*	.35	3.91	0.50	0.25-0.99
Constant	-1.26***	.23	30.45	---	
Previous psychiatric hospitalization					
Block 1					
Excessiveness	0.30	.25	1.444	1.35	0.83-2.22



Constant	-1.51***	.24	40.59	---	
Block 2					
Excessiveness	-0.73	.51	2.04	0.48	0.18-1.31
Uncontrollability	1.08*	.26	5.34	2.95	1.18-7.36
Constant	-1.62***	.26	38.93	---	

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*Note.* All measures were assessed using the Anxiety Disorders Interview Schedule.

† =  $p < .10$ . \* =  $p < .05$ . \*\* =  $p < .01$ . \*\*\* =  $p < .001$ .

## CHAPTER 3: DEVELOPMENT AND VALIDATION OF THE BELIEFS ABOUT THOUGHT CONTROL SCALE

### **Abstract**

Unwanted thoughts are a feature of several emotional disorders, including generalized anxiety disorder (GAD) and obsessive-compulsive disorder (OCD). The belief that thoughts can and should be controlled has been highlighted as a potential etiological and maintaining factor in GAD and OCD and may represent a common cognitive vulnerability for these disorders. Current measures of need to control thoughts are largely content-specific, focusing on particular types of thoughts (worries, obsessions) or thought control strategies (suppression), precluding evaluation of need to control thoughts as a transdiagnostic process. The present paper describes the development and preliminary validation of the Beliefs About Thought Control Scale (BATC), a 14-item general measure of need to control thoughts. The BATC demonstrated strong internal consistency and convergent and discriminant validity vis-à-vis existing self-report measures. The BATC also demonstrated incremental validity in predicting the severity of interviewer-assessed GAD and its cardinal feature, worry, over and above a worry-specific measure of need to control thoughts. The present findings highlight the utility of a broadened conceptualization of need to control thoughts and support the BATC as an efficient and effective measure of this construct.

Nearly everyone experiences unwanted thoughts<sup>2</sup> from time to time. The student who finds his mind wandering during an important lecture; the insomniac who cannot sleep because of her whirring thoughts; the new mother who has a disturbing image of hurting her child—few among us have not had such experiences. However, there is considerable individual variation in the frequency of these thoughts, as well as in the cognitive and emotional reactions that these thoughts elicit. Several anxiety and mood disorders, including generalized anxiety disorder (GAD) and obsessive-compulsive disorder (OCD), among others, are characterized by an excess of such thoughts. The core feature of GAD is excessive and uncontrollable worry; difficulty concentrating is also a symptom. Obsessions in OCD generally take the form of intrusive thoughts that the individual feels compelled to neutralize (*Diagnostic and Statistical Manual-IV [DSM-IV]*; American Psychiatric Association, 2000). The essence of each of these symptoms is that the sufferer wants to control his or her thoughts but feels unable to do so.

With a few exceptions, research on the control of such thoughts has occurred within a disorder- or content-specific framework (Beck, 1976; Beck & Perkins, 2001). For example, uncontrollable worry is generally studied in the context of GAD (Behar, DiMarco, Hekler, Mohlman, & Staples, 2009) and obsessional thoughts in the context of OCD (Obsessive Compulsive Cognitions Working Group [OCCWG], 1997). A common theme that has emerged across these largely separate bodies of research is a proposed role for metacognitive beliefs, particularly the belief that certain thoughts can and should be controlled, in the development and maintenance of GAD and OCD as well as major

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<sup>2</sup> In the present paper, the term “thoughts” refers to all internally observable cognitive events, including images as well as verbal-linguistic content.

depressive disorder (MDD), post-traumatic stress disorder (PTSD), and other emotional disorders (Purdon, 1999). Prominent cognitive-behavioral models of GAD (Wells, 1994; 1995; Wells & Carter, 1999) and OCD (Frost & Steketee, 2002) suggest a central role for need to control thoughts in the etiology and maintenance of these disorders. This commonality raises a potentially important question: Might beliefs about the importance of controlling thoughts represent a common cognitive vulnerability for GAD, OCD, and other disorders characterized by uncontrollable thought? If so, might this common vulnerability help to explain the elevated comorbidity of these disorders (Kessler, Chiu, Demler, & Walters, 2005) or suggest a common target for intervention? Unfortunately, current measures are largely content-specific (i.e., refer specifically to worries or obsessions) and consequently are ill-suited to test this general hypothesis. The present study aimed to address this gap in the literature by developing a general measure of need to control thoughts.

The metacognitive model of GAD (Wells, 1994a, 1995, 1999) argues that Type 2 worry, or “meta-worry,” is central to the development of GAD. In contrast to Type 1 worry, or worry about external events (e.g., finances) or internal non-cognitive events (e.g., one’s health), Type 2 worry is defined as “worrying about worry, appraising negative thoughts as uncontrollable, and reflecting a desire to control thoughts” (Wells, 1995, p. 304). This model emerged in part from the development of the Anxious Thoughts Inventory (AnTI; Wells, 1994a). Factor analysis of the AnTI suggested a meta-worry subscale, including items such as “I think I am missing out on important things in my life because of worry,” which incrementally predicted trait worry after trait anxiety

and Type 1 worries (assessed by other subscales of the AnTI) were controlled (Wells & Carter, 1999).

The Meta-Cognitions Questionnaire (MCQ; Cartwright-Hatton & Wells, 1997) and its revised version, the MCQ-30 (Wells & Cartwright-Hatton, 2004), is the measure most frequently used to test predictions of the metacognitive model of GAD. The Need to Control Thoughts subscale of the MCQ-30 (for clarity, hereafter designated Need to Control Worry) includes several items related to beliefs about thought control, including “If I did not control a worrying thought and it happened, it would be my fault,” “If I could not control my thoughts, I would not be able to function,” and “It is bad to think certain thoughts.” This subscale, along with the Uncontrollability and Danger subscale, which assesses beliefs about the uncontrollability and potential negative consequences of worry, has been found to mediate the relationship between trait worry and self-reported severity of GAD symptoms (Penney, Mazmanian, & Rudanycz, 2013).

The belief that thoughts can and should be controlled is also featured in cognitive-behavioral models of OCD. Building on models proposed by Salkovskis (1985; 1989) and Rachman (1997), the OCCWG (1997, 2001; Frost & Steketee, 2002) proposed six belief domains hypothesized to contribute to OCD symptoms: need to control thoughts, excessive responsibility, overimportance of thoughts, perfectionism, and intolerance of uncertainty. Another model (Clark & Purdon, 1993) suggests a more central role for need to control thoughts. Specifically, unrealistic beliefs about the extent to which thoughts can be controlled (“one can and must have perfect control over one’s thoughts”) are proposed to produce an urgent desire to suppress obsessional thoughts. Because thought suppression attempts often fail (Wegner, Schneider, Carter, & White, 1987),

negative beliefs about the uncontrollability of thoughts are maintained, purportedly contributing to a vicious circle that maintains OCD symptoms.

The OCCWG developed two self-report measures to test the relationship of metacognitive beliefs to OCD symptoms. The Interpretation of Intrusions Inventory (III; OCCWG, 1997, 2001) was developed to assess immediate appraisals of obsessional thoughts. The III asks participants to nominate two recent obsessional thoughts and to rate the frequency and severity of those thoughts as well as specific beliefs about those thoughts. The III was developed to include three rationally-derived subscales: Importance of Thoughts, Control of Thoughts, and Responsibility. However, these subscales were found to be highly correlated ( $r > .80$ ) and to load onto a single factor (OCCWG, 2005), suggesting a close or indistinguishable relationship among these constructs as assessed by the III.

The 87-item Obsessive Beliefs Questionnaire (OBQ; OCCWG, 2001), later shortened to a 44-item version (OBQ-44; OCCWG, 2005), is a more widely used measure of beliefs that are proposed to characterize OCD. Although the factor structure of the OBQ-44 varies across studies, Importance/Control of Thoughts (for clarity, hereafter designated Importance/Control of Obsessions; “I should not have bizarre or disgusting thoughts”) has consistently emerged as a distinct factor that was strongly associated with OCD symptoms (Myers, Fisher, & Wells, 2008; OCCWG, 2005). However, evidence for the specificity of this subscale to OCD is mixed. Supporting the subscale’s specificity, participants with OCD were found to score higher than a comparison group of participants with other anxiety disorders (primarily panic disorder; OCCWG, 2005). The subscale also incrementally predicted self-reported and

interviewer-assessed OCD symptoms over and above trait worry and all other subscales (Myers et al., 2008). However, the subscale showed relatively weak discriminant validity, remaining moderately positively associated with self-reported anxiety and depression after OCD symptoms were statistically controlled (OCCWG, 2001).

The Meta-Cognitive Beliefs Questionnaire (MCBQ; Clark, Purdon, & Wang, 2003) is another, less widely used measure of beliefs about obsessions. The initial validation study for this measure suggested a three-factor solution, including Thought [Obsession] Control Beliefs (“I believe that it is my responsibility to have better control over my unwanted, unacceptable intrusive thoughts”). Providing mixed evidence for the specificity of the measure, the Obsession Control Beliefs subscale was moderately associated with self-reported OCD symptoms and weakly associated with self-reported anxiety and depression.

Taken together, these findings suggest that beliefs about the need to control thoughts are associated with, but not unique to, GAD and OCD. Despite these observations, few studies have examined the specificity of beliefs about control over worry versus obsessions to GAD and OCD, respectively. The few studies that have examined these relationships have generally provided mixed results. Consistent with the suggestion that need to control thoughts is not disorder-specific, one study (Wells & Cartwright-Hatton, 2004) found that the Uncontrollability and Danger of worry subscale of the MCQ-30 incrementally predicted the frequency of obsessional thoughts over and above trait worry and Type 1 worry. However, Uncontrollability and Danger incrementally predicted trait worry after OCD symptoms (including frequency of obsessional thoughts) were controlled. In another study using the MCQ-30 (Gwilliam,

Wells, & Cartwright-Hatton, 2004), Need to Control Worry incrementally predicted self-reported OCD symptoms over and above trait anxiety and trait worry. Taken together, these findings suggest that a broader perspective on thought control beliefs is warranted.

The thought suppression literature represents an important exception to the largely disorder- and content-specific research reviewed above. This literature is primarily concerned with the effectiveness and consequences of a particular style of thought control (i.e., suppression, or effortfully pushing a thought out of one's mind) rather than the content of such thoughts.

Although empirical support for ironic process theory (Wegner, 1994), the leading theoretical model of thought suppression, has been mixed (Abramowitz, Tolin, & Street, 2001), the construct of thought suppression has garnered considerable attention. In particular, researchers have hypothesized a role for the habitual use of thought suppression in the development of OCD, GAD, MDD, PTSD, and specific phobia (see Purdon, 1999 for a review).

The 15-item White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994) is the most widely used measure of thought suppression. Higher scores are generally moderately to strongly associated with more severe anxiety and depression, with no consistent disorder-specific relationship observed (Wenzlaff & Wegner, 2000). However, as is often noted (e.g., Rassin, 2003), the WBSI contains several items that assess perceived thought control ability ("I have thoughts that I cannot stop") as well as efforts to control thoughts ("I always try to put problems out of my mind"). The inclusion of such items makes it difficult to isolate the precise construct the scale assesses (Höping & de Jong-Meyer, 2003) and to determine whether the observed correlations



with emotional distress are driven by efforts or failures to control thoughts. An additional limitation of the scale is that it focuses almost exclusively on thought suppression. As there are many strategies that individuals can use to exert control over thoughts (e.g., reappraisal, distraction; Wells & Davies, 1994), thought suppression may not be equally elevated in all individuals who espouse a strong need to control thoughts.

### **The Present Study**

Across several literatures, need to control thoughts has emerged as a construct of considerable interest. Unfortunately, existing measures are inadequate to test the hypothesis that this belief represents a common cognitive vulnerability for disorders characterized by uncontrollable thought. The OBQ-44, III, and MBCQ were designed to refer to obsessional thoughts; overlap with worry was explicitly minimized in several of these measures (OCCWG, 2001). In contrast, the AnTI and MCQ-30 explicitly reference worry but not obsessions. The content-specific nature of these measures reduces their utility for testing transdiagnostic hypotheses. The WBSI addresses some of these limitations in that it is not disorder- or content-specific. However, because the scale does not distinguish efforts and failures to control thoughts, and because it assesses only one method of effortful thought control, it is ill-suited to address hypotheses about the precise role of thought control beliefs in disorders characterized by uncontrollable thought.

A further, more subtle limitation of existing content-specific measures is the focus on control over anxiety-provoking or otherwise upsetting thoughts, rather than “thoughts” more broadly construed. Individuals attempt to control many kinds of thought in daily life; efforts to resist mind-wandering, distractions, and emotionally neutral unwanted thoughts (e.g., a song stuck in one’s head) are common occurrences. Currently, little is

known about beliefs about and reactions to such thoughts. Might a strong desire to control even neutral thoughts serve as an early marker of—or risk factor for—burgeoning psychopathology? Alternatively, might such beliefs indicate non-pathological or even positive characteristics, such as conscientiousness, self-control, or grit?

The present paper aimed to address limitations in the extant literature by developing, refining, and beginning to validate the Beliefs About Thought Control scale (BATC; pronounced “bat-see”), a general measure of need to control thoughts. A wide variety of items designed to tap multiple facets of control over thoughts were included. Based on an extensive review of the literature, two broad facets were considered: importance of controlling thoughts, including negative consequences of and emotional reactions to thought control failures; and efforts to control thoughts, including habitual use of thought control strategies and efforts to resist distraction or mind-wandering. To minimize redundancy with existing measures, related constructs already well-represented in the literature (e.g., thought-action fusion; Shafran, Thordarson, & Rachman, 1996) were not included. In addition to the development and preliminary validation of the scale, hypotheses related to the incremental validity of a general “need to control thoughts” construct were tested.

The initial hypotheses were as follows:

1. Factor structure: Competing hypotheses were tested. The BATC was predicted to have a single-factor or a two-factor (importance of control and efforts to control) solution. In either case, the full-scale BATC was predicted to show strong internal consistency.

2. Convergent and discriminant validity: The BATC was predicted to exhibit moderate to strong positive associations with existing measures of need to control anxious thoughts and weak or absent associations with theoretically unrelated constructs.
3. Relationship to positive personality constructs: Exploratory analyses were conducted to investigate the relationship between need to control thoughts and three positive personality dimensions viewed as potentially related to a strong need to control thoughts: conscientiousness, self-control, and grit.
4. Relationship to perceived thought control ability: Competing hypotheses were tested. Previous research suggested a negative association between perceived thought control ability and GAD and OCD symptoms (Luciano, Algarabel, Tomás, & Martínez, 2005). It was therefore predicted that the BATC, a measure also predicted to be related to GAD and OCD symptoms, would demonstrate a similarly negative association. However, this previously observed relationship may have been driven by the severity of anxious thought. Specifically, individuals with particularly severe anxious thoughts may be likely to endorse both a desire to control such thoughts and an inability to do so. Because the BATC does not emphasize anxious thoughts, a weaker or absent relationship with perceived thought control ability was also considered.
5. Incremental validity and relationship to GAD and OCD: The BATC was predicted to exhibit moderate to strong zero-order associations with measures of GAD and OCD symptoms. Furthermore, the BATC was hypothesized to demonstrate incremental validity in predicting GAD symptoms and trait worry

(the core feature of GAD) over and above the Need to Control Worry subscale of the MCQ-30. This hypothesis was made on the basis of the broader range of thought control facets assessed by the BATC (e.g., efforts to control thoughts, which is not assessed by the Need to Control Worry subscale) and the stronger anticipated psychometric properties of the BATC vis-à-vis the Need to Control Worry subscale.

These hypotheses were tested over a series of four successive studies. In the first study, an initial pool of items was administered to a development sample of 345 undergraduate students. The goal of this study was to select items for inclusion in the final scale, evaluate the factor structure of the BATC, and provide preliminary tests of the convergent and discriminant validity and incremental utility of the measure. In the second study, the refined BATC was administered to a validation sample of 149 undergraduate participants. The goal of the second study was to replicate the results of Study 1 using the shorter measure. In the third study, the BATC and a new set of convergent and discriminant validity measures were administered to an Internet-based sample of 233 adults. The goals of Study 3 were to replicate a subset of the results in Studies 1 and 2, to provide further evidence for the discriminant validity of the BATC, and to evaluate the psychometric properties of the BATC in a non-student sample. In the fourth study, the BATC was administered to a sample of 45 community-dwelling adults with and without GAD who were recruited and diagnosed as part of a larger ongoing study. The primary goal of Study 4 was to provide a preliminary replication of the primary findings from Studies 1, 2, and 3 in a clinical sample vis-à-vis healthy controls.

To facilitate comparison of results across studies, the method and results are organized by hypothesis rather than by study. For clarity, we refer to Samples rather than Studies in the remainder of the paper.

## **Method**

### **Participants and Procedure**

**Sample 1.** Participants were 345 undergraduate students (64% female;  $M$  age = 19.24,  $SD$  = 1.19) recruited over 3 semesters from the Psychology Department subject pool at the University of Pennsylvania. To reduce participant burden, data were collected in two waves, with measures partially overlapping across waves.

**Sample 2.** Participants were 149 undergraduate students (67% female;  $M$  age = 19.21,  $SD$  = 1.09; 48% Caucasian, 24% Asian or Asian-American, 7% Latino/a, 5% African American, and 16% other ethnicity or multiethnic) recruited from the same university during a single semester. In Samples 1 and 2, participants received course credit in exchange for participation.

**Sample 3.** Participants were 233 adults (55% female, 1% transgender;  $M$  age = 36.59,  $SD$  = 12.46; 80% Caucasian, 7% African-American, 6% Asian-American, 4% Latino/a, and 3% other ethnicity or multiethnic) recruited via the Amazon mechanical Turk (mTurk) website. As in Shapiro, Chandler, and Mueller (2013), participation was restricted to native English-speaking United States residents with an established history of satisfactory completion of mTurk tasks. Quality control questions (“respond ‘almost always’ to this question”) were embedded throughout the study to permit identification of noncompliant or inattentive participants. Participants who responded incorrectly to one or more quality control questions or who completed the questionnaire battery

unrealistically quickly (less than 10 minutes) were excluded from analyses (17 participants; 7% of the total sample). Data were recruited in two waves, with measures partially overlapping between waves. Participants received modest monetary compensation (\$0.50 – \$1.00) for participating. In Samples 1, 2, and 3, study measures were completed online via a secure website.

**Sample 4.** Participants were 45 community-dwelling adults (75% female;  $M$  age = 32.83,  $SD$  = 10.87) recruited as part of a larger ongoing study. Participants were diagnosed with GAD ( $n$  = 22) or were healthy controls with no current or past Axis I disorders ( $n$  = 23). Comorbidity was common among the clinical participants; additional Axis I diagnoses included social anxiety disorder ( $n$  = 11), OCD ( $n$  = 5), MDD ( $n$  = 5) panic disorder with agoraphobia ( $n$  = 3), specific phobia ( $n$  = 4), and PTSD ( $n$  = 2). Diagnoses were made by trained interviewers using the Anxiety Disorders Interview Schedule-IV (ADIS-IV; DiNardo, Barlow, & Brown, 1994). The sample was ethnically diverse and demographically comparable to the larger Philadelphia community (47% Caucasian, 37% African-American, 9% Asian or Asian-American, 4% Latino/a, 2% other ethnicity or multiethnic). Measures were completed using pencil and paper in a private room. Participants received monetary compensation (\$10 per hour) in exchange for participating.

### **Development of the BATC**

After a thorough literature review, items were developed to systematically sample potentially relevant content associated with the construct of need to control thoughts. Items were written primarily by the first author with some items drawn from existing thought control measures. Consistent with the goal of developing a general measure,

items that directly referenced worries, obsessions, or other disorder-specific content were avoided. Items with neutral phrasing (e.g., “I have strategies I often use to keep my thoughts under control”) were favored. However, items referencing emotional reactions to uncontrollable thought (e.g., “I become anxious if I realize I have let my mind wander”) were included, as such reactions were viewed as relevant to the construct of need to control thoughts. Several passes were made through the item pool to eliminate items that were needlessly wordy, “double barreled” or otherwise unclear, or insufficiently representative of the target construct (Smith & McCarthy, 1995).

The initial BATC included 45 items (see Appendix A). Items were rated on a 5-point Likert-type scale with anchors at each point (1: Strongly Disagree; 2: Disagree; 3: Neutral or Don’t Know; 4: Agree; 5: Strongly Agree). Consistent with conventional conceptualizations of beliefs about thought control as trait-like variables, participants were instructed to rate “how [they] generally feel” (instructions adapted from Luciano et al., 2005).

### **Convergent Validity**

Participants completed four self-report measures viewed as conceptually similar to the BATC:

**Need to Control Worry subscale of the Metacognitions Questionnaire-30 (MCQ-30; Wells & Cartwright-Hatton, 2004).** The MCQ-30 is a measure of metacognitive beliefs, with a particular emphasis on beliefs about worry. It contains 30 items and five subscales. The five-item Need to Control Worry subscale was identified as the existing measure most conceptually similar to the BATC. In prior research, this subscale evidenced adequate internal consistency ( $\alpha = 0.72$ ) and convergent validity but

unclear factor loadings (Wells & Cartwright-Hatton, 2004). Other subscales (sample items in parentheses) include: Positive Beliefs about Worry (“I need to worry in order to work well,”  $\alpha = 0.92$ ); Cognitive Self-Consciousness (“I constantly examine my thoughts,”  $\alpha = 0.92$ ); Cognitive Confidence (“I do not trust my memory,”  $\alpha = 0.93$ ); and Uncontrollability and Danger (see Relationship to Perceived Control Over Thoughts, below). The full MCQ-30 was administered to all participants in Samples 1, 2, and 3 and a subset of Sample 4 ( $n = 24$ ).

**White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994).** The WBSI is a 15-item measure of efforts and failures to suppress thoughts (“I always try to put problems out of my mind;” “There are images that come to mind that I cannot erase”). The scale has shown good convergent validity in a student sample (Wegner & Zanakos, 1994). The WBSI was administered to Samples 1 and 2.

**Importance/Control of Obsessions subscale of the Obsessive Beliefs Questionnaire-44 (OBQ-44; OCCWG, 2005).** The OBQ-44 is a 44-item measure of beliefs implicated in the development and maintenance of OCD symptoms. The Importance/Control of Obsessions subscale (“Having a bad thought is morally no different from doing a bad deed”) was identified as conceptually similar to the BATC. The OBQ-44 also contains two other empirically-derived subscales: Responsibility/Threat Estimation (“Harmful events will happen unless I am very careful”  $\alpha = 0.93$ ); and Perfectionism/Certainty (“For me, things are not right unless they are perfect”  $\alpha = 0.93$ ). The scale has shown good internal consistency and criterion-related validity among unselected students and individuals with OCD (OCCWG, 2005). The full OBQ-44 was administered to Samples 1 and 2.



**Interpretation of Intrusions Inventory (III; OCCWG, 2001; 2003).** The III is a 31-item measure of metacognitive interpretations of intrusive obsessional thoughts. Participants read a description and several examples of obsessional thoughts, nominate two recent obsessional thoughts, and rate the extent to which they hold various beliefs about those and similar thoughts (0 – 100; “I am irresponsible if I don’t resist this unwanted thought;” “If I ignore this thought, I could be responsible for serious harm”). Ratings are summed and divided by 10 prior to interpretation. The III has three rationally-derived subscales: Control of Thoughts, Importance of Thoughts, and Responsibility. However, factor analytic, reliability, and validity analyses suggest that the III is best conceptualized as a single-factor measure (OCCWG, 2005;  $\alpha = 0.94$ ). The full-scale III score was therefore used in all analyses. The III was administered to Sample 3.

### **Discriminant Validity**

To test the specificity of the BATC, a variety of discriminant validity measures were administered. Domain-general desire for control was included to represent a conceptually similar but theoretically distinct construct; the other measures were predicted to be unrelated or negligibly associated with need to control thoughts.

**Desirability of Control Scale (DCS; Burger & Cooper, 1979).** The DCS is a 20-item measure of domain-general desire for control (“When it comes to orders, I would rather give them than receive them;” “I enjoy making my own decisions”). The measure exhibited adequate internal consistency, test-retest reliability, and discriminant validity in a student sample. The DCS was administered to a subset of Sample 1 ( $n = 244$ ) and to all participants in Sample 2.

**Agreeableness and Extraversion subscales of the Big Five Inventory (BFI; John, Naumann, & Soto, 2008).** The BFI is a widely-used 44-item measure of five domains of personality (Agreeableness; Conscientiousness; Extraversion; Neuroticism; Openness to Experience). The full BFI was administered; however, only the 9-item Agreeableness (“I see myself as someone who likes to cooperate with others”) and 8-item Extraversion (“I see myself as someone who is talkative”) subscales were predicted to be unrelated to need to control thoughts. The BFI was administered to a subset of Sample 3( $n = 147$ ).

**Trait Anger subscale of the State-Trait Anger Expression Inventory-2 (STAXI-2-TA; Spielberger, 1999).** The STAXI-2-TA is a measure of tendency to experience anger (“I am a hotheaded person”). The measure has demonstrated good internal consistency and convergent validity (Spielberger, 1999). The STAXI-2-TA was administered to a subset of Sample 3( $n = 147$ ).

**Hostility, Phobic Avoidance, Psychoticism, and Somatization subscales of the Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994).** The SCL-90-R is a widely-used 90-item measure of nine dimensions of psychopathology with reasonably strong reliability, convergent validity, and discriminant validity, despite an unclear factor structure (Groth-Marnat, 2009). The full SCL-90-R was administered; however, only the Hostility, Phobic Avoidance, Psychoticism, and Somatization subscales were predicted a priori to be unrelated to need to control thoughts. The SCL-90-R was administered to a subset of Sample 3( $n = 70$ ).

**Marlow-Crowne Social Desirability Scale-Short Form-X1 (SDS; Strahan & Gerbasi, 1972).** The SDS is a widely-used 10-item measure of tendency to respond in a

socially desirable manner (“I like to gossip at times,” reverse-scored) with adequate reliability. The SDS was administered to a subset of Sample 3 ( $n = 70$ ).

### **Relationship to Positive Personality Characteristics**

To explore the relationship of need to control thoughts to positive personality characteristics associated with self-control and self-discipline, three measures were administered to a subset of Sample 3 ( $n = 147$ ).

**Conscientiousness subscale of the BFI (John et al., 2008).** The Conscientiousness subscale of the BFI is a 9-item measure of responsibility, orderliness, and dependability (“I am someone who does a thorough job”) with generally strong psychometric properties (John et al., 2008).

**Self-Control Scale (SCS; Tangney, Baumeister, & Boone, 2004).** The SCS is a 39-item measure of domain-general perceived self-control (“I am good at resisting temptation”). The SCS has strong internal consistency, good convergent and discriminant validity, and a consistently negative association with psychopathology (Tangney et al., 2004).

**Short Grit Scale (GRIT-8; Duckworth & Quinn, 2009).** The GRIT-8 is a brief measure of perseverance for and dedication to long-term goals. The GRIT-8 has adequate internal consistency and strong convergent validity (Duckworth & Quinn, 2009).

### **Relationship to Perceived Thought Control Ability**

Four self-report measures were administered to test the relationship of need to control thoughts with perceived ability to control thoughts, including two measures of general thought control ability and two measures relating to uncontrollability of worry.

**Thought Control Ability Questionnaire (TCAQ; Luciano et al., 2005).** The TCAQ is a 25-item measure of perceived thought control ability (“My thoughts control me more than I control them;” “There are some thoughts that enter my head without me being able to avoid it”) with good internal consistency and convergent validity in student samples (Luciano et al., 2005; Williams et al., 2010). The TCAQ was administered to Samples 1, 2, and 3.

**Attentional Control Scale (ACS; Derryberry & Reed, 2001).** The ACS is an increasingly-used 20-item measure of perceived attentional control (“My concentration is good even if there is music in the room around me”). The ACS demonstrated generally strong psychometric properties in an Icelandic student sample (Ólaffson et al., 2011). Past research has suggested a two-factor solution: Focusing (“When concentrating I ignore feelings of hunger or thirst”) and Shifting (“I can quickly switch from one task to another”). However, because these factors were found to be strongly correlated ( $r = .74$ ), the Shifting factor showed inadequate internal consistency ( $\alpha = .68$ ), and the full-scale ACS is most often used, the total score was used in the present study. The ACS was administered to a subset of Sample 1 ( $n = 242$ ) and all participants in Sample 2.

**Uncontrollability and Danger subscale of the MCQ-30 (MCQ-30; Wells & Cartwright-Hatton, 2004).** The Uncontrollability and Danger subscale is a 6-item measure of negative beliefs about worry, with particular emphasis on uncontrollability (“My worrying thoughts persist, no matter how I try to stop them”) and danger (“My worrying is dangerous for me”). The subscale has demonstrated excellent internal consistency ( $\alpha = .91$ ) and strong convergent validity vis-à-vis a measure of trait worry (Wells & Cartwright-Hatton, 2004).

**Meta-Worry subscale of the Anxious Thoughts Inventory (AnTI; Wells, 1994a).** The AnTI is a 22-item self-report measure of worry. The 7-item Meta-Worry (“worry about worry”) subscale assesses the process and content of worry, with an emphasis on themes of uncontrollability (“I worry that I cannot control my thoughts as well as I would like to”). The full AnTI was administered; however, only the Meta-Worry scale assesses uncontrollability of worry and was analyzed here. The AnTI was administered to a subset of Sample 1 ( $n = 114$ ).

### **Relationship to GAD and OCD**

Self-report and clinician-rated measures of GAD and OCD symptoms were administered to test the hypothesized positive relationship of the BATC to these symptoms.

**Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990).** The PSWQ is a widely-used 16-item self-report measure of trait worry (“My worries overwhelm me”). The PSWQ has demonstrated strong reliability and convergent validity in undergraduate samples (Meyer et al., 1990) as well as good sensitivity and specificity in discriminating individuals with GAD from those with social anxiety or no anxiety disorder (Fresco, Mennin, Heimberg, & Turk, 2003). The PSWQ was administered to Samples 1, 2, and 4.

**Padua Inventory-Washington State University Revision (PI-R; Burns, 1995).** The PI-R is a 39-item self-report measure of obsessions and compulsions with strong psychometric properties (Burns, Keortge, Formea, & Sternberger, 1996). The PI-R was adapted from the original Padua Inventory (Sanavio, 1988) to minimize what was viewed as problematic overlap with worry in the original measure. The PI-R contains five

rationally-derived subscales (Contamination, Grooming, Checking, Harm Thoughts, Harm Impulses); however, the full-scale PI-R has been shown to have excellent internal consistency ( $\alpha = .92$ ; Burns et al., 1996) and was considered the most informative measure of OCD symptoms. The PI-R was administered to a subset of Sample 3 ( $n = 70$ ).

**GAD and OCD modules of the Anxiety Disorders Interview Schedule-IV (ADIS-IV; DiNardo et al., 1994).** Because common method bias can inflate estimates of the associations between constructs (Campbell & Fiske, 1959), a multimethod assessment of the relationship between need to control thoughts and symptoms is desirable. Therefore, GAD and OCD symptoms were also assessed using the ADIS-IV, a “gold standard” semi-structured interview for assessing *DSM-IV* anxiety and mood disorders that has demonstrated strong psychometric properties (Brown, Di Nardo, Lehman, & Campbell, 2001; Grisham, Brown, & Campbell, 2004). Disorder severity ratings are made on a 0 – 8 scale, with a cut-off of 4 representing a clinically significant and diagnosable disorder. Interviewers received extensive training on administration of the ADIS-IV and were blind to BATC score. The ADIS-IV was administered to Sample 4.

### **Relationship to Other Constructs of Interest**

Several widely-used self-report measures were administered to situate the BATC within the broader literature on emotional distress, GAD, and OCD.

**Spielberger State-Trait Anxiety Inventory-Trait Version (STAI-T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).** The STAI-T is a widely-used 20-item measure of trait anxiety (“I feel like difficulties are piling up so that I cannot

overcome them”). The STAI-T has shown good to excellent internal consistency and test-retest reliability (Spielberger et al., 1983). The STAI-T was administered to Samples 1 and 2.

**Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996).** The BDI-II is a widely-used self-report measure of dysphoria. The BDI-II consists of 21 scored items, each of which includes four statements that describe a symptom of depression in increasing levels of severity (“I can’t get any pleasure from the things I used to enjoy”). Participants select the statement that best describes how they felt generally over the past week. Although the BDI-II has been shown to have a two-factor structure (Dozois, Dobson, & Ahnberg, 1988), the total score is most often used. The BDI-II was administered to a subset of participants in Sample 1 ( $n = 219$ ) and to all participants in Sample 2.

**Reflection and Brooding subscales of the Response Styles Questionnaire-Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991).** The RRS is a 22-item self-report measure of trait rumination, or the tendency to engage in negative, perseverative thought when in a sad mood. It has two subscales: Reflection (“analyze recent events to try to understand why you are depressed”) and Brooding (“think about a recent situation, wishing it had gone better”), the latter of which is more strongly associated with depression and anxiety (Watkins, 2008). The RRS has demonstrated strong psychometric properties in prior research (Nolen-Hoeksema & Morrow, 1991). The RRS was administered to a subset of participants in Sample 1 ( $n = 249$ ) and to all participants in Sample 2.

**Intolerance of Uncertainty Scale (IUS; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994).** The IUS is a 27-item self-report measure of intolerance of uncertainty, or discomfort with ambiguity and the possibility, no matter how unlikely, of negative outcomes (“When I am uncertain, I can’t go forward;” “The ambiguities in life stress me”). Intolerance of uncertainty is elevated in individuals with GAD and OCD (Gentes & Ruscio, 2011) and has been proposed to play a central role in the development of these disorders (Dugas, Buhr, & Ladouceur, 2004; Holoway, Heimberg, & Coles, 2006; Tolin, Abramowitz, Brigidi, & Foa, 2003). The IUS has generally strong psychometric properties (Freeston et al., 1994).

**Frost Multidimensional Perfectionism Scale (FMPS; Frost, Marten, Lahart, & Rosenblate, 1990).** The FMPS is a 35-item measure of perfectionism (“If I fail at work/school, I am a failure as a person;” “Even when I do something very carefully, I often feel that it is not quite right”). The FMPS has been suggested to contain six (Frost et al., 1990) or four (Stöber, 1998) subscales; however, the total score can also be interpreted and was used in the present analyses. The FMPS was administered to a subset of Sample 1 ( $n = 222$ ).

## **Results**

### **Item Selection and Factor Structure**

The initial pool of 45 items was reduced by examining the initial item and scale properties in Sample 1. Items were systematically and iteratively considered for exclusion on the grounds of redundancy with psychometrically preferable or more clearly-worded items, poor initial psychometric properties (e.g., very low variability), or minimal item-total correlations. Alpha-if-item-deleted was also considered. Items with



non-optimal but still adequate psychometric properties were retained when necessary to ensure adequate coverage of the construct. This led to the removal of 22 items.

Responses to the remaining 23 items were subjected to exploratory factor analysis (EFA) using oblique rotation to permit correlations among factors. MPlus was used for all factor analyses; SPSS was used for all other analyses. Missing data composed less than 5% of the total available data and were handled using listwise deletion. All factor analyses were conducted using the weighted least squares mean and variance (WLSMV) adjusted estimator. WLSMV was selected because traditional maximum likelihood (ML) estimators can yield biased estimates when indicators are categorical or ordinal, as in the case of Likert-type responses (Brown, 2006; Wirth & Edwards, 2007). WLSMV approaches result in more accurate estimates than those generated using ML estimators (Wirth & Edwards, 2007).

The factor analysis began by extracting all factors with eigenvalues  $> 1$  (Kaiser-Guttman criterion), resulting in the identification of 5 factors. Inspection of the scree plot (Cattell, 1966) suggested that 2 factors should be extracted. Parallel analysis (conducted using software developed by Watkins, 2008) also recommended extraction of 2 factors. Examination of the factor loadings suggested a primary “need to control thoughts” factor onto which 10 items loaded significantly and exclusively, and a secondary factor onto which 2 reverse-scored items (“It doesn’t matter if my mind wanders” and “I can lose control of my thoughts and still be successful”) loaded significantly and exclusively. The remaining 11 items loaded on both factors. Because the secondary factor was not considered theoretically meaningful, and because only two items loaded cleanly onto that factor, a single-factor solution was preferred.

To improve the fit of the single-factor solution and further improve the efficiency of the measure, reliability and item analyses were conducted to identify psychometrically weaker items that could be eliminated from the scale without compromising content coverage. The two items that loaded on the second factor and items that loaded on both factors were considered good candidates for elimination. Item and scale characteristics (inter-item correlations and alpha-if-item-deleted), factor loadings, and content coverage were considered in determining items to discard. Six additional items were removed based on these considerations. Finally, the EFA was re-run with a forced single-factor solution. This process resulted in a 15-item scale with good internal consistency (Cronbach's  $\alpha = .86$ ) and adequate single-factor structure,  $\chi^2(90) = 276.95, p < .001$ ; CFI = 0.93; TLI = 0.91; RMSEA = 0.079. This 15-item scale was administered to all subsequent samples.

To evaluate the consistency of the factor structure, confirmatory factor analysis (CFA) was used in Samples 2 and 3. Due to sample size limitations, factor analyses were not performed in Sample 4. Examination of the modification indices<sup>3</sup> for these analyses suggested one item ("I just let my thoughts come naturally," reverse-scored) which, if removed, would considerably improve model fit. After considering the theoretical importance of this item and implications for reliability, it was determined that this item should be removed. This resulted in a 14-item scale with good internal consistency ( $\alpha = .89$ ). Despite the removal of this item, however, no consistent factor solution emerged across the various samples. Specifically, the single-factor solution was not confirmed in

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<sup>3</sup> Modification indices provide estimates of the extent to which the model fit would be improved if a given parameter was freed.

Sample 2 ( $\chi^2(90) = 201.31, p < .001$ ; CFI = 0.94; TLI = 0.93; RMSEA = 0.09) or Sample 3 ( $\chi^2(77) = 423.86, p < .001$ ; CFI = 0.87; TLI = 0.85; RMSEA = 0.14). Follow-up EFA suggested a three-factor solution for Sample 2 ( $\chi^2(63) = 114.96, p < .001$ ; CFI = 0.97; TLI = 0.96; RMSEA = 0.07), which was replicated using CFA in Sample 1 ( $\chi^2(74) = 190.74, p < .001$ ; CFI = 0.95; TLI = 0.94; RMSEA = 0.07) but was not replicated in Sample 3 ( $\chi^2(74) = 374.23, p < .001$ ; CFI = 0.89; TLI = 0.86; RMSEA = 0.13). EFA in Sample 3 suggested a theoretically uninterpretable 6-factor solution ( $\chi^2(22) = 53.88, p < .001$ ; CFI = 0.99; TLI = 0.95; RMSEA = 0.08). With a few exceptions (e.g., in the 6-factor solution), correlations between EFA-derived subscales were strong ( $r \geq .54$ ).

### **Internal Consistency**

The 14-item BATC exhibited strong internal consistency in all four samples ( $\alpha = 0.85 - 0.91$ ). Mean scores and standard deviations were also comparable across the four samples ( $M = 39.73 - 42.22$ ;  $SD = 8.17 - 10.92$ ). BATC scores did not differ by sex (all  $p > .40$ ). Given the uniformly strong internal consistency of the 14-item BATC, the inconsistencies in the observed factor structure, and the strong intercorrelations between EFA-identified factors, the full-scale BATC was used in lieu of subscales for all subsequent analyses.

### **Convergent Validity**

Table 1 presents the correlations between BATC and the other measures included in the study, as well as the internal consistency of each measure. Across each sample, we observed the predicted moderate to strong positive associations between the BATC and measures of need to control anxious thoughts, suggesting that these measures tap similar but not redundant constructs. The association between BATC and WBSI was positive

but smaller, suggesting a conceptual distinction between need to control thoughts and efforts/failure to suppress thoughts as assessed by these measures.

### **Discriminant validity**

As shown in Table 1, BATC was weakly associated or unassociated with domain-general desire for control, trait anger, agreeableness, extraversion, hostility, phobic avoidance, psychoticism, and socially desirable responding ( $r = -.10 - .25$ ). BATC was moderately associated with somatization ( $r = .32$ ), suggesting a closer relationship between this construct and need to control thoughts than initially hypothesized. Taken together, the overall pattern of convergent and discriminant validity analyses suggests that BATC is a reasonably sensitive and specific measure of need to control thoughts.

### **Relationship to Positive Personality Characteristics**

No significant relationship was observed between BATC and conscientiousness, self-control, or grit ( $r = -.15 - -.04$ ), suggesting that need to control thoughts as assessed by the BATC is unrelated to these constructs.

### **Relationship to Perceived Thought Control Ability**

The relationship between BATC and perceived thought control ability varied considerably across the samples. Samples 1 and 2 revealed a small to moderate negative relationship between the BATC and TCAQ ( $r = -.23 - -.37$ ). Similarly, Sample 2 revealed a small negative relationship between the BATC and ACS ( $r = -.20$ ). However, the BATC was unrelated to the ACS in Sample 1 ( $r = -.09$ ) or to the TCAQ in Sample 3 ( $r = .10$ ), suggesting a weak or absent relationship between need to control thought and perceived ability to control thought as assessed by these measures.

The BATC was moderately positively related to meta-worry in Sample 1 ( $r = .33$ ) and moderately to strongly related to Uncontrollability and Danger of Worry across all samples ( $r = .24 - .64$ ). The relationship with Uncontrollability and Danger was relatively weaker in Sample 3 ( $r = .24$ ) and stronger in Sample 4 ( $r = .74$ ). Because the case-control design of Sample 4 may have artificially inflated the relationships observed therein, the analysis was repeated including only participants with GAD. A similarly strong association was observed,  $r = .64, p = .040$ .

### **Relationship to Other Constructs of Interest**

The BATC showed consistently weak to moderate positive associations with measures of constructs that have been linked to emotional disorders, including trait anxiety ( $r = .25 - .37$ ), dysphoria ( $r = .16 - .36$ ), intolerance of uncertainty ( $r = .43$ ), brooding ( $r = .22 - .37$ ), reflection ( $r = .19 - .21$ ), and perfectionism ( $r = .36$ ).

### **Relationship to GAD and OCD**

The relationship between BATC and trait worry was moderate to strong in Samples 1 and 2 ( $r = .31 - .42$ ) and strong in Sample 4 ( $r = .52$ ). BATC was also positively associated with GAD severity ( $r = .43$ ) and OCD severity ( $r = .45$ ) assessed via the ADIS-IV, suggesting that the relationship between need to control thoughts and symptoms cannot be explained solely by common methodological variance. However, these associations did not hold when only GAD-diagnosed participants ( $n = 22$ ) were included in the analyses (PSWQ  $r = .14, p = .560$ ; GAD severity  $r = -.05, p = .814$ ; OCD severity  $r = .38, p = .160$ ), suggesting that the BATC may not predict severity among participants already experiencing uncontrollable anxious thought. BATC scores were

also moderately positively associated with OCD symptoms ( $r = .33$ ) as assessed by the PI-R in Sample 3.

### **Incremental Validity of the BATC for Predicting GAD Symptoms**

Having observed moderate to large, statistically significant associations of the BATC with measures of GAD and OCD symptoms, we examined whether these associations held even after controlling for a disorder-specific measure of need to control thoughts. A series of linear hierarchical regression analyses tested the incremental validity of the BATC in predicting trait worry severity, the core symptom of GAD.<sup>4</sup> If the BATC incrementally predicts disorder symptoms over and above disorder-specific measures of need to control thoughts, it may highlight the potential utility of a transdiagnostic approach to measuring and studying need to control thoughts. If, however, the BATC does not explain additional variance in symptoms, it would suggest that current content-specific approaches may be equally useful. In all analyses, high leverage points (identified using Cook's distance) were identified and excluded from analyses (less than 2% of cases). All variance inflation factors were less than 2.18, suggesting that multicollinearity was not a problem.

As shown in Table 2, BATC explained an additional 2% –42% of the variance in trait worry scores over and above need to control worry as assessed by the MCQ-30. This finding was statistically significant in Samples 1, 2, and 4—including in the

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<sup>4</sup> Parallel analyses could not be performed for Need to Control Obsessions and OCD symptoms, as these measures were administered to non-overlapping samples in the present study.

subsample of GAD-diagnosed participants—and was marginally significant in Sample 3. Notably, the BATC incrementally explained the largest portion of variance (42%) among GAD-diagnosed participants in Sample 4. This finding stands in contrast to the nonsignificant zero-order associations of BATC scores with trait worry and GAD severity in this subsample. In all cases, Need to Control Worry was no longer a significant predictor of trait worry once BATC was included in the model. As shown in Table 3, BATC also incrementally predicted ADIS-IV GAD severity in Sample 4, explaining an additional 21% of the variance in GAD severity; this effect was of a similar magnitude (18% of the variance) but was nonsignificant in the smaller GAD-diagnosed subsample.

### **Discussion**

The belief that thoughts must be controlled has been posited as an etiological and maintaining factor for several emotional disorders, including GAD and OCD, among others (Clark & Purdon, 1993; Wells, 1995; 1999). The identification of this construct across several disparate literatures raises the question: Might need to control thoughts represent a common cognitive vulnerability for disorders characterized by uncontrollable thought? Existing measures are inadequate to test this hypothesis. Most measures refer explicitly to certain types of thoughts, such as obsessional intrusive thoughts (the OBQ-44 and III) or worry (the AnTI and MCQ-30). The few nonspecific measures have other important limitations, including an exclusive focus on particular thought control strategies and a confounding of desire, attempts, and failures to control thoughts (e.g., the WBSI; Wegner & Zanakos, 1994). The present study aimed to address these limitations by developing and validating the Beliefs About Thought Control scale (BATC), a brief

self-report measure of need to control thoughts, broadly defined. Across four samples, the BATC showed strong internal consistency, convergent and discriminant validity, and incremental validity in predicting GAD symptoms over and above an existing measure of need to control worry.

The present findings should be interpreted in light of several limitations. First, the factor structure of the BATC was inconsistent across the samples. Exploratory and confirmatory factor analyses variously suggested a single factor structure, a three-factor structure, and a six-factor structure. Examination of the three-factor structure, which was the only structure replicated using CFA, suggested that the first factor generally represented beliefs about control of thoughts (e.g., “I need to feel in control of my thoughts”), with the second and third factors representing efforts to control thoughts (“I almost always try to keep my mind from wandering”) and emotional reactions to loss of control (“I become anxious if I realize I have let my mind wander”), respectively. However, there was some overlap in item content across factors, and the factors were highly correlated ( $r \geq .54$ ). Taken together, the factor analytic findings suggest that the “need to control thoughts” construct may be multifaceted and that these facets are not clearly articulated by the BATC in its current instantiation. The BATC was developed with the goal of balancing brevity and cost-efficiency with satisfactory coverage of a broad construct. This balance arguably was achieved: the measure shows high internal consistency ( $\alpha \geq .85$ ) and is only 14 items long, allowing need to control thoughts to be assessed in a matter of minutes. Nevertheless, the development of a long-form version of the BATC, perhaps with additional items that prototypically represent the facets



suggested by the three-factor solution, would be a valuable step toward clarifying the underlying structure of this construct.

A second limitation is the absence of test-retest reliability data. Beliefs about thought control are generally conceptualized as trait-like variables; to our knowledge, there are no “state” measures of such beliefs. The BATC operates from this conventional trait-like perspective in that participants report “how [they] generally feel.” The presumed temporal stability of the BATC thus remains to be evaluated. However, it is also important to acknowledge that beliefs about thought control may well fluctuate over time. Fluctuations could be influenced by intrapersonal variables such as mood or the recent occurrence of unwanted thoughts, or by contextual variables such as location or activity (e.g., work versus home). These possibilities are underscored by the strong but imperfect test-retest reliabilities reported for similar existing measures (e.g.,  $r = 0.74$  and  $r = 0.85$  for the Need to Control Worry and Obsessions subscales of the MCQ-30 and OBQ-44, respectively). Research on the stability of beliefs about thought control could substantially deepen our understanding of the nature of these beliefs and their relationship to symptoms of emotional disorders. Furthermore, the identification of situations in which such beliefs are less strongly endorsed could facilitate the development or implementation of interventions designed to weaken these beliefs.

A third limitation of the BATC is that it cannot be used to identify the types of thoughts a person aims to control. For example, some individuals may want to control all kinds of thoughts, while others may be concerned only with control over obsessional thoughts; others may still be more distressed by an inability to resist mind-wandering. Because there are many existing measures of beliefs about control over specific types of

thoughts, we intentionally set out to develop a content-general measure that could be used across thought types and disorders. However, a long-form version of the BATC might explicitly reference the many types of thoughts a person could attempt to control (e.g., worries, obsessions, ruminations, intrusive memories, and mind-wandering, among others) in addition to neutral, nonspecific items. It is possible that a clearer factor structure would emerge in such a measure. Might such a measure suggest a higher-order factor of “need to control thoughts” as well as content-specific subfactors uniquely associated with certain disorders? Additional research is needed to address this potentially fruitful question.

With these limitations in mind, the present findings suggest that the BATC is a useful and valid measure of need to control thoughts. Supporting the convergent validity of the measure, the BATC was strongly associated but not redundant with measures of need to control anxious thoughts across four diverse samples ( $r = .42 - .76$ ). Consistent with the proposed relationship between need to control thoughts and disorders characterized by uncontrollable anxious thought, the BATC showed moderate to strong associations with trait worry ( $r = .31 - .52$ ), two self-report measures of OCD symptoms ( $r = .33 - .40$ ), and interviewer-rated GAD severity ( $r = .43$ ) and OCD severity ( $r = .45$ ).

The relationship between need to control thoughts and perceived ability to control thoughts was somewhat complex. Consistent with research suggesting an inverse relationship between thought control attempts and successes (Wegner & Zanakos, 1994), Sample 1 showed a moderate negative relationship ( $r = -.37$ ) between the BATC and thought control ability as assessed by the TCAQ. However, this relationship was weaker in Sample 2 ( $r = -.23$ ) and absent in Sample 3 ( $r = .10$ ). The relationship was similarly

weak-to-absent for perceived attentional control as assessed by the ACS ( $r = -.09 - -.23$ ). The findings were somewhat more consistent for the relationship with uncontrollability of worry: the BATC was positively related to both meta-worry ( $r = .33$ ) and uncontrollability and danger beliefs about worry ( $r = .24 - .74$ ). The relationship with uncontrollability and danger was strongest in Sample 4 (the clinical sample) and weakest in Sample 3 (the Internet-based sample), with the undergraduate samples intermediate. Because both worry-related subscales assess beliefs about danger as well as about uncontrollability of worry, strong conclusions about the relationship of need to control thoughts and uncontrollability of worry are not warranted. However, these findings are broadly suggestive of a negative association between desire and perceived ability to control thoughts. In any event, the present findings strongly support a conceptual distinction between desire and perceived ability to control thoughts and argue for the use of measures that distinguish—rather than confound—these constructs in future research.

The BATC also demonstrated incremental utility in predicting GAD symptoms. In a series of conservative analyses wherein need to control worry (assessed by the MCQ-30) was statistically controlled, need to control thoughts (assessed by the BATC) accounted for additional variance (2 – 42%) in trait worry and interviewer-rated GAD severity. This finding was significant in three of the four samples and marginally significant in the remaining sample. In all samples, need to control worry no longer predicted symptoms once need to control thoughts was included in the model. Because this finding could potentially be explained in part by the larger range of scores and therefore greater statistical power of the BATC relative to the MCQ-30 subscale, strong theoretical conclusions about the role of general versus disorder-specific beliefs about

control over thoughts in GAD would be premature. Nevertheless, this finding suggests that the traditional emphasis in the GAD literature on need to control worry—versus need to control thoughts more broadly construed—and the measures used to assess this construct—may be overly specific. Additional research with a larger mixed clinical sample would be valuable to further articulate the zero-order and incremental associations of need to control thoughts with GAD, OCD, and other disorders characterized by uncontrollable anxious thought.

In addition to convergent validity and incremental utility, the BATC also showed evidence of specificity, with weak or absent associations observed with domain-general desire for control, trait anger, agreeableness, extraversion, hostility, phobic avoidance, and psychoticism. The null relationship with phobic avoidance, which is characterized by fear but not uncontrollable anxious thought, is particularly notable. This finding hints at a specific relationship between need to control thoughts and forms of psychopathology characterized by uncontrollable thought, rather than (or perhaps over and above) a nonspecific association of need to control thoughts with general emotional distress. Consistent with this interpretation, the BATC showed consistently positive but variable associations with trait anxiety ( $r = .25 - .37$ ) and dysphoria ( $r = .16 - .36$ ). The BATC was moderately associated with intolerance of uncertainty ( $r = .43$ ), a construct strongly implicated in GAD, OCD, and depression, three disorders characterized by uncontrollable thought (Gentes & Ruscio, 2011). The BATC also showed a moderate positive association with perfectionism ( $r = .36$ ). This association is perhaps unsurprising given the strong wording of some items in the BATC (e.g., “being out of control of my thoughts is a sign of weakness”); indeed, a high score on the BATC would

represent a fairly rigid and perfectionistic approach toward control over thoughts. Perfectionism is also elevated in many anxiety disorders, particularly OCD (Purdon, Antony, & Swinson, 1999), which also may help to explain the moderate association with the BATC.

Notably, the BATC showed an unexpected moderate positive association with somatization ( $r = .32$ ). One possible interpretation is that this relationship represents an additional example of the weak to moderate association of need to control thoughts with measures of general emotional distress. However, because this relationship was identified in only one sample, additional replication is warranted before drawing strong conclusions.

One exploratory question was whether need to control thoughts could be conceptualized as an adaptive characteristic, perhaps associated with conscientiousness, self-control, or grit. One might imagine, for example, a person who views thought control as a necessary prerequisite to the achievement of occupational or personal goals. Indeed, one item of the BATC represents the belief that control over thoughts is important for success; several other items represent efforts to resist distraction and mind-wandering. Nevertheless, the BATC was nonsignificantly negatively associated with each of these personality traits ( $r = -.04--.15$ ). These findings suggest that need to control thoughts may best be conceptualized as a potentially maladaptive belief. Consistent with this conceptualization, the BATC was generally more strongly associated

with brooding ( $r = .22 - .37$ ) than reflection ( $r = .19 - .22$ )<sup>5</sup>, which represent more and less pathological forms of rumination, respectively (Watkins, 2008).

Taken together, the present findings underscore the potential utility of a broadened approach to studying beliefs about thought control. This observation is consistent with a general movement in the field toward transdiagnostic, rather than disorder-specific, conceptualizations of many cognitive and behavioral processes (Harvey, Watkins, Mansell, & Shafran, 2004). The development of a brief, psychometrically promising measure that assesses need to control thoughts in a content-general way, yet is correlated in the expected directions with relevant forms of psychopathology, represents one contribution to this growing movement. Consistent with a “common cognitive vulnerability” hypothesis, need to control thoughts was positively associated with self-reported and interviewer-assessed GAD and OCD symptoms. Need to control thoughts also incrementally predicted trait worry and interviewer-rated GAD severity over and above a content-specific measure of need to control worry. These findings were generally consistent across four diverse samples—including two student samples, an Internet-based sample of United States residents, and a sample of community-dwelling adults with and without GAD, among other disorders—underscoring the potential utility of the new measure.

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<sup>5</sup>This difference in strength of association was statistically significant in Sample 1 ( $t(246) = 2.59, p = .011$ ) but not Sample 2 ( $t(147) = 0.24, p = 0.811$ ).

The inconsistencies observed in the factor structure, together with a lack of clarity in the extant literature about the essential features of the construct (e.g., a conflation of desire and ability to control thoughts), suggest that additional research is needed to articulate the main facets and underlying structure of need to control thoughts. Furthermore, additional research is needed to support the conceptualization of need to control thoughts as a common cognitive vulnerability for disorders characterized by uncontrollable thought. As the present studies were cross-sectional, it remains possible that need to control thoughts is a consequence rather than a cause of elevated GAD and OCD symptoms. Third variable explanations (e.g., uncontrollable anxious thought causes both need to control thoughts and disorder symptoms) are also possible. Experimental research and prospective research with mixed clinical or at-risk samples would be particularly valuable for testing hypotheses about need to control thoughts as a transdiagnostic cognitive vulnerability. If need to control thoughts is confirmed as a cognitive vulnerability, interventions could then be developed to challenge and modify these beliefs. These interventions would have the advantage of being applicable to a broad range of cases, and therefore potentially more efficient and cost-effective to develop, test, and disseminate than disorder-specific interventions.

## Appendix A

### Initial Item Pool

\* = Retained in the final 14-item Thought Control Scale.

1. If I have an upsetting thought, I don't worry about it much.
2. I work very hard to keep my mind focused on the task at hand.
3. I need to feel in control of my thoughts.\*
4. I almost always try to keep my mind from wandering.\*
5. Controlling my thoughts is important to me.
6. I just let my thoughts come naturally.
7. I feel badly about myself if I lose control of my thoughts.\*
8. I don't try to control my thoughts.\*
9. I work very hard to keep certain thoughts out of my mind.\*
10. I don't usually try to change what I'm thinking about.
11. I don't like feeling out of control of my thoughts.\*
12. If I can't control my thoughts, I can't control much of anything.\*
13. Being in control of thoughts is important for success.\*
14. It's important for me to "keep an eye" on the kinds of things I'm thinking about.
15. It's important for me to keep control over what I'm thinking about.
16. It doesn't bother me to lose control of my thoughts for a moment.
17. I've found that certain strategies are better than others for keeping my thoughts under control.
18. It's impossible for a person to completely control their thoughts, so I don't bother trying to control mine.



19. I shouldn't let my mind wander.\*
20. Being out of control of my thoughts means I am an undisciplined person.
21. It's okay for me to feel distracted sometimes.
22. It bothers me if I can't change what I'm thinking about.
23. Disciplined people sometimes lose control of their thoughts.
24. It doesn't matter if my mind wanders.
25. It bothers me if I can't concentrate on something.
26. Being out of control of my thoughts is a sign of weakness.\*
27. It's important for me to keep my thoughts under control.
28. If I don't keep close control over my thoughts it will be hard to get things done.
29. I get annoyed with myself if I realize I have let my attention wander.\*
30. I become anxious if I lose control of my thoughts.
31. I have strategies I often use to keep my thoughts under control.\*
32. I spend a lot of time trying to change what I'm thinking about.
33. I feel like I'm always trying to keep my mind on task.
34. It's important for me to be able to choose what I think about.
35. I become anxious if I realize I have let my mind wander.\*
36. I usually make an effort to keep control over my thoughts.
37. It doesn't matter whether I have control over my thoughts.
38. I always try to keep my mind from wandering.
39. If I have a thought that bothers me, I usually just let it go.
40. I can still get things done even if my mind wanders.
41. I can lose control of my thoughts and still be successful.

42. Controlling one's thoughts should be easier than controlling almost anything else.
43. It's okay for me to feel distracted.\*
44. It is impossible for anyone to keep close control over their thoughts.
45. I can lose control of my thought sometimes and still be a disciplined person.

## Appendix B

### Beliefs About Thought Control Scale

A number of statements that people have used to describe themselves are given below.

Read each statement and then write next to it the appropriate number to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement; give the answer which seems to describe how you generally feel.

1-----2-----3-----4-----5				
Strongly Disagree	Disagree	Neutral or	Agree	Strongly
Disagree		Don't Know		Agree

1. I need to feel in control of my thoughts.
2. I almost always try to keep my mind from wandering.
3. I feel bad about myself if I lose control of my thoughts.<sup>a</sup>
4. I don't try to control my thoughts. (R)
5. I work very hard to keep certain thoughts out of my mind.
6. I don't like feeling out of control of my thoughts.
7. If I can't control my thoughts, I can't control much of anything.
8. Being in control of thoughts is important for success.
9. I shouldn't let my mind wander.
10. Being out of control of my thoughts is a sign of weakness.

11. I get annoyed with myself if I realize I have let my attention wander.
12. I have strategies I often use to keep my thoughts under control.
13. I become anxious if I realize I have let my mind wander.
14. It's okay for me to feel distracted. (R)

<sup>a</sup>In the validation studies, this item was worded “I feel badly about myself if I lose control of my thoughts.” The item was rephrased after data collection for grammatical reasons. This change is not expected to influence patterns of responding to this item.

(R) indicates reverse-scored items.

Table 1  
Internal Consistencies and Pearson Correlations with the Beliefs About Thought Control Scale

Variable	Sample 1				Sample 2				Sample 3				Sample 4			
	<i>n</i>	<i>α</i>	<i>r</i>	<i>p</i>	<i>n</i>	<i>α</i>	<i>r</i>	<i>p</i>	<i>n</i>	<i>α</i>	<i>r</i>	<i>p</i>	<i>n</i>	<i>α</i>	<i>r</i>	<i>p</i>
Convergent Validity																
Need to Control Worry (MCQ-30)	323	.81	.56	<.001	149	.76	.59	<.001	217	.80	.53	<.001	23	.85	.76	<.001
Importance/Control of Obsessions (OBQ-44)	322	.90	.42	<.001	149	.89	.43	<.001	---	---	---	---	---	---	---	---
Thought Suppression (WBSI)	321	.90	.25	<.001	149	.90	.29	.001	---	---	---	---	---	---	---	---
Interpretation of Intrusions (III)	---	---	---	---	---	---	---	---	70	.95	.46	<.001	---	---	---	---
Discriminant Validity																
Desire for Control (DCS)	244	.84	.03	.700	149	.83	-.16	.057	---	---	---	---	---	---	---	---
Trait anger (STAXI-2-TA)	---	---	---	---	---	---	---	---	147	.88	.21	.011	---	---	---	---
Agreeableness (BFI)	---	---	---	---	---	---	---	---	147	.86	-.10	.212	---	---	---	---
Extraversion (BFI)	---	---	---	---	---	---	---	---	147	.87	-.10	.210	---	---	---	---
Somatization (SCL-90-R)	---	---	---	---	---	---	---	---	70	.88	.32	.008	---	---	---	---
Hostility (SCL-90-R)	---	---	---	---	---	---	---	---	69	.68	.08	.515	---	---	---	---
Phobic avoidance (SCL-90-R)	---	---	---	---	---	---	---	---	70	.87	.18	.136	---	---	---	---
Psychoticism (SCL-90-R)	---	---	---	---	---	---	---	---	70	.78	.25	.034	---	---	---	---
Social desirability (SDS)	---	---	---	---	---	---	---	---	67	.77	.05	.711	---	---	---	---
Positive Personality Characteristics																
Conscientiousness (BFI)	---	---	---	---	---	---	---	---	147	.86	-.04	.658	---	---	---	---
Self-control (SCS)	---	---	---	---	---	---	---	---	147	.92	-.11	.201	---	---	---	---
Grit (GRIT-8)	---	---	---	---	---	---	---	---	147	.77	-.15	.065	---	---	---	---
Perceived Thought Control Ability																
Thought Control Ability (TCAQ)	317	.89	-.37	<.001	149	.90	-.23	.004	217	.94	.10	.130	---	---	---	---
Attentional Control (ACS)	242	.83	-.09	.194	149	.81	-.20	.013	---	---	---	---	---	---	---	---
Uncontrollability and Danger (MCQ-30)	322	.87	.47	<.001	149	.87	.39	<.001	217	.91	.24	<.001	39	.92	.74	<.001
Meta-Worry (AnTI)	114	.84	.33	<.001	---	---	---	---	---	---	---	---	---	---	---	---
Generalized Anxiety Disorder and Obsessive-Compulsive Disorder																
Trait worry (PSWQ)	330	.94	.42	<.001	149	.93	.31	<.001	---	---	---	---	39	.95	.52	<.001
GAD clinical severity (ADIS-IV)	---	---	---	---	---	---	---	---	---	---	---	---	62	---	.43	.004
OCD symptoms (PI-R)	---	---	---	---	---	---	---	---	70	.94	.33	.005	---	---	---	---
OCD symptoms (SCL-90-R)	---	---	---	---	---	---	---	---	69	.87	.40	.001	---	---	---	---
OCD clinical severity (ADIS-IV)	---	---	---	---	---	---	---	---	---	---	---	---	29	---	.45	.014
Other Constructs of Interest																
Trait anxiety (STAI-T)	326	.91	.37	<.001	149	.92	.25	.002	---	---	---	---	---	---	---	---
Dysphoria (BDI-II)	219	.87	.36	<.001	148	.87	.16	.057	---	---	---	---	---	---	---	---
Intolerance of Uncertainty (IUS)	314	.94	.43	<.001	---	---	---	---	---	---	---	---	---	---	---	---
Brooding (RRS)	249	.80	.37	<.001	149	.85	.22	.006	---	---	---	---	---	---	---	---
Reflection (RRS)	249	.76	.21	.001	149	.74	.19	.019	---	---	---	---	---	---	---	---
Perfectionism (FMPS)	222	.90	.36	<.001	---	---	---	---	---	---	---	---	---	---	---	---

Note. MCQ-30 = Meta-Cognitions Questionnaire-30; OBQ-44 = Obsessive Beliefs Questionnaire - 44; WBSI = White Bear Suppression Inventory; III = Interpretation of Intrusions Inventory; DCS = Desire for Control Scale; STAXI-2-TA = Trait Anger subscale of the State-Trait Anger Inventory-2; BFI = Big Five Inventory; SDS = Social Desirability Scale; SCL-90-R = Symptom Checklist-90-Revised; GRIT-8 = Short Grit Scale; TCAQ = Thought Control Ability Scale; ACS = Attentional Control Scale; AnTI = Anxious Thoughts Inventory; PSWQ = Penn State Worry Questionnaire; ADIS-IV = Anxiety Disorders Interview Schedule-IV; PI-R = Padua Inventory - Washington State University Revision; STAI-T = State/Trait Anxiety Inventory-Trait Version; BDI-II = Beck Depression Inventory-II; IUS = Intolerance of Uncertainty Scale; RRS = Ruminative Responses Scale; FMPS = Frost Multidimensional Perfectionism Inventory. Sample sizes vary because some measures were administered to only a subset of participants in each sample. Dashes represent measures that were not administered to that sample.

Table 2

*Incremental prediction of trait worry (PSWQ) by the Beliefs about Thought Control Scale*

Model and predictors	<i>B</i>	<i>SE (B)</i>	$\beta$	$R^2$	$\Delta R^2$
Sample 1 ( <i>n</i> = 321)					
Model 1				.05	.05***
Need to Control Worry (MCQ-30)	0.94***	0.24	.22		
Model 2				.18	.13***
Need to Control Worry (MCQ-30)	-0.08	0.26	-.02		
BATC	0.66***	0.09	.43		
Sample 2 ( <i>n</i> = 149)					
Model 1				.08	.08***
Need to Control Worry (MCQ-30)	1.02***	0.28	.29		
Model 2				.11	.03*
Need to Control Worry (MCQ-30)	-0.56	0.34	.16		
BATC	0.30*	0.13	.22		
Sample 3 ( <i>n</i> = 145)					
Model 1				.07	.07*
Need to Control Worry	-0.38	1.16	.27		
Model 2				.09	.02 <sup>†</sup>
Need to Control Worry (MCQ-30)	0.64	0.34	.19		
BATC	0.24 <sup>†</sup>	0.15	.16		
Sample 4 ( <i>n</i> = 23)					
Model 1				.30	.30**

Need to Control Worry (MCQ-30)	1.95**	0.66	.55		
Model 2				.63	.34***
Need to Control Worry (MCQ-30)	-0.47	0.75	-.13		
BATC	1.29***	0.30	.89		

---

*Note.* PSWQ = Penn State Worry Questionnaire; BATC = Beliefs About Thought Control

Scale; MCQ-30 = Meta-Cognitions Questionnaire-30.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Table 3

*Incremental prediction of GAD severity (ADIS-IV) by the Beliefs about Thought Control*

*Scale in Sample 4*

Model and predictors	<i>B</i>	<i>SE (B)</i>	$\beta$	$R^2$	$\Delta R^2$
Sample 4 ( $n = 21$ )					
Model 1				.26	.26*
Need to Control Worry (MCQ-30)	0.27	0.10	.51		
Model 2				.47	.21*
Need to Control Worry (MCQ-30)	0.004	0.13	.01		
BATC	0.16*	0.06	.68		

*Note.* ADIS-IV = Anxiety Disorders Interview Schedule-IV; BATC = Beliefs

About Thought Control Scale; MCQ-30 = Meta-Cognitions Questionnaire-30.

\* $p < .05$ .



CHAPTER 4: FRACTIONATING THE ROLE OF EXECUTIVE CONTROL IN  
CONTROL OVER WORRY

**Abstract**

Uncontrollable anxious thought characterizes a number of emotional disorders. Little is known, however, about the cognitive mechanisms that underlie the ability to control these thoughts. The present study investigated the extent to which two well-characterized executive control processes—working memory and inhibition—are engaged when an individual attempts to control worry. Participants completed a concurrent assessment of these processes while attempting to control personally-relevant worried and neutral thoughts. To examine the specificity of these effects to attempts to control worry, versus a residual “depletion” effect of having previously engaged in worry, a subset of participants completed the assessment without instructions to control their worried or neutral thoughts. Attempts to control worry engaged working memory and inhibition to a greater extent than did attempts to control neutral thought. This increased engagement was not explained solely by anxious affect, nor was it significantly associated with trait worry. Engagement did not differ by group, suggesting that executive control depletion by worry cannot be dismissed as an alternative explanation of these findings. These findings highlight working memory and inhibition as potentially valuable constructs for deepening our understanding of the nature and treatment of worry and its control.

Uncontrollable worry is the core feature of generalized anxiety disorder (GAD), a disorder associated with impaired quality of life, decreased productivity, and substantial economic burden (Hoffman, Dukes, & Wittchen, 2008). Among individuals with GAD, higher perceived uncontrollability (i.e., difficulty of sustained dismissal) of worry is associated with greater clinical severity, even after other features of GAD are controlled (Hallion & Ruscio, 2013). Uncontrollable worry also affects many adults who do not qualify for a diagnosis of GAD (Ruscio et al., 2005) yet still suffer negative physical and emotional consequences (Watkins, 2008). Although treatments for worry have improved over time, many individuals continue to experience uncontrollable worry and its adverse consequences even after treatment (Mitte, 2005).

One reason for the limited success of current treatments may be our limited understanding of the “cold” cognitive mechanisms that underlie the experience and control of worry and other unwanted thoughts. Intentionally attending to certain stimuli while ignoring others engages a number of executive control processes, the limited cognitive resources that underlie the ability to control information at the forefront of one’s mind (Cowan, 2005). Two of the most widely recognized and well-characterized executive control processes are working memory (WM), the mental workspace responsible for storing and manipulating information over short periods of time, and inhibition, the ability to deliberately override a prepotent response in order to make a task-appropriate but less dominant response (Miyake et al., 2000).

A small but growing body of research suggests a link between executive control and the experience of worry and other unwanted thoughts (Sarason, 1988; Hirsch & Mathews, 2012). For example, higher trait worry and GAD are associated with poorer

performance on some—but not all—WM tasks (Christopher & MacDonald, 2005; Crowe, Mathews, & Walkenhorst, 2007). In experimental research, depressed individuals demonstrated impairments in WM and inhibition after a period of experimentally induced rumination (a negative, repetitive thought process similar to worry), but experienced no such impairments after neutral thought (Philippot & Brutoux, 2008; Watkins & Brown, 2002). Similarly, high worriers experienced impaired WM while worrying, but not while thinking positive thoughts (Hayes, Hirsch, & Mathews, 2008). Consistent with theoretical accounts of worry as a primarily verbal-linguistic process (Borkovec, Robinson, Pruzinsky, & DePree, 1983), WM is particularly impaired when participants worry in verbal, rather than imagery, form (Leigh & Hirsch, 2011), and ability to worry is impaired during verbal, but not visuospatial, WM tasks (Rapee, 1993).

A recent theoretical account suggests that the impairments in executive control that are evoked by worry may contribute to the maintenance of uncontrollable worry (Hirsch & Mathews, 2012). Broadly, this model proposes that redirecting one's thoughts away from worry relies on the very executive control resources that worry engages. That is, worry produces impairments in executive control, which subsequently prevent the worrier from terminating his or her worry. The findings reviewed above support the first stage of this model (i.e., worry impairs executive control). However, the proposal that attempts to control worry rely on the same resources that are impaired by worry remains untested.

Some indirect support for this possibility comes from the thought suppression literature. Greater WM has been linked to better ability to suppress anxiety-provoking thoughts in healthy adults (Brewin & Smart, 2005; although see Nixon, Cain, Nehmy, &

Seymour, 2009a; Wessel, Overwijk, Verwoerd, & de Vrieze, 2008). Experimental research suggests that the addition of a WM load impairs participants' abilities to suppress thoughts about an upsetting film (Nixon, Cain, Nehmy, & Seymour, 2009b) and that WM training improves healthy participants' ability to suppress unwanted thoughts (Bomyea & Amir, 2011). Other indirect support comes from emotion regulation studies, which have shown a positive association between WM and the ability to modulate the experience and expression of emotion (Schmeichel, 2007; Schmeichel, Volokhov, & Demaree, 2008). For example, one study found that attempting to exaggerate emotional responding had a lasting "depleting" effect on WM (Schmeichel, 2007).

Although these findings are suggestive, no studies have tested directly whether, and to what extent, attempts to control worry rely on executive control. It is also unknown which executive control processes are particularly engaged by such attempts. This gap in the literature is a major obstacle to identifying the causes of uncontrollable anxious thought and identifying targets for intervention. An emerging body of research suggests that WM may be modifiable through training (e.g., Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Shipstead, Redick, & Engle, 2012). If impairments in specific executive control processes contribute to difficulty controlling worry, interventions that strengthen those processes could prove a valuable and resource-effective adjunct to traditional cognitive-behavioral therapy for uncontrollable worry and GAD.

The present study examined the extent to which attempting to control worry draws on the two executive control processes most reliably linked to worry and rumination: WM and inhibition. All participants engaged in experimentally induced worry and neutral thought. After each thought induction, a subset of participants

(“Control Thoughts” group) attempted to control those worried and neutral thoughts while simultaneously completing a computerized measure of WM and inhibition. This dual task approach capitalizes on the limited nature of executive control: To the extent that controlling worry relies on a specific executive control process (e.g., WM), performance on a concurrently performed task that relies on the same process should suffer (e.g., Engle, Conway, Tuholski, & Shisler, 1995). As little is known about the extent to which thought control strategies differentially rely on executive control, participants in the Control Thoughts group were randomly assigned to use one of three common thought control strategies to control both their worry and neutral thoughts.

As the present study assessed WM and inhibition after participants engaged in worry, it was possible that impairment in executive control observed during attempts to control worry could be a consequence of having engaged in worry, rather than of attempting to control that worry. To our knowledge, no studies have shown a lasting “depleting” effect of worry on executive control, although such an effect would be consistent with recent theoretical accounts of worry and executive control (Hirsch & Mathews, 2012). To test the specificity of the effects to efforts to control worry, a second subset of participants (“No Instruction” group) completed the executive control task without being instructed to control their worries or neutral thoughts. We hypothesized that attempts to control worry would result in poorer WM and inhibition performance compared to attempts to control neutral thought. We further hypothesized that participants who attempted to control worry would experience greater executive control impairment than participants who worried but did *not* attempt to control their thoughts.

## **Method**

## Participants

Participants were 100 undergraduate students (56% female) at a large northeastern university. All were age 18 or older, with normal or corrected-to-normal vision, no history of traumatic brain injury, no current use of stimulant medications, and no current or previous use of antipsychotic medications. As undergraduate samples include the full range of possible worry scores (Ruscio, Borkovec, & Ruscio, 2001), no requirements based on trait worry or GAD status were imposed.

## Materials

**Experimental apparatus.** The experiment was administered on Dell Pentium IV desktop computers. To minimize potential experimenter effects, the entire procedure was administered using E-Prime Professional (version 2.0). Stimuli were presented in black ink on a light gray background and were centered on the computer screen.

**Executive control.** Participants completed the WM and Inhibition Task (WMIT; Hallion & Jha, 2011), a novel computerized task that provides a simultaneous assessment of the availability of WM—particularly the maintenance component of WM—and inhibition resources. Assessing WM and inhibition simultaneously, rather than sequentially, facilitates within-subjects comparisons and reduces the likelihood that fatigue or mind wandering could confound the results.

The stimuli and general instructions for the WMIT were adapted from the AX-Continuous Performance Task (Barch et al., 1997). In the WMIT, participants view a series of letter stimuli (see Figure 1). Stimuli are presented individually for 150ms each. Each letter stimulus is followed by a 300ms fixation cross. After every third letter stimulus, the fixation cross is presented for 1300ms and participants are asked to respond

as follows: Press “k” if the last letter was X, but only if it was preceded by A. Press “f” in all other cases (i.e., when the last letter is any letter other than X, or when the last letter is X preceded by any letter other than A).

The WMIT comprises high- and low-demand trials for both executive control processes, as follows:

WM: The WM component of the WMIT was adapted from the N-back task (Jonides et al., 1997). On low demand trials (60 trials), participants report whether an A was presented immediately prior to the X (i.e., one-back). On high demand trials (60 trials), participants report whether an A was presented two stimuli prior to the X (i.e., two-back). The order of high and low WM demand trials was counterbalanced throughout the task.

Inhibition: The inhibition component of the WMIT was adapted from a widely used response inhibition task (Braver, Barch, Gray, Molfese, & Snyder, 2001). The WMIT is designed such that the correct response is “k” (i.e., A before X) on 70% of trials (84 trials) and “f” (i.e., not A before X) on 30% of trials (36 trials). Trials that warrant an “f” response are high demand trials because the participant needs to inhibit a prepotent response, whereas trials that warrant a “k” response are low demand trials because inhibition is not required. The order of high and low inhibition demand trials was pseudorandomized and counterbalanced across high and low WM demand trials.

WMIT responses are analyzed in terms of accuracy and reaction time (RT). The relative availability of each executive control process is determined by subtracting performance on low demand trials (which do not rely on executive control and instead reflect nonspecific effects such as slowing or fatigue) from performance on high demand

trials (which reflect nonspecific effects plus executive control demands). This subtraction yields a single “cost score” that reflects the extent to which that executive control process is impaired or engaged by a competing task (e.g., controlling worry).

The WMIT has good concurrent and discriminant validity vis-à-vis established measures of executive control. In a separate validation study, performance on the WM and inhibition components of the WMIT correlated  $r = .40$  and  $r = .50$  with performance on the gold standard Operation Span (OSPAN) test of WM (Unsworth, Heitz, Schrock, & Engle, 2005) and the widely used Response Inhibition test of inhibition (Braver et al., 2001), respectively. Performance on the WM and inhibition components of the WMIT were not significantly associated with one another ( $r = .05$ ), suggesting these processes are relatively independent in the WMIT.<sup>6</sup>

**Worry and anxiety assessment.** Participants rated state anxiety during the experiment using a 0 – 100 rating scale (e.g., Hayes et al., 2008). Participants also completed the Penn State Worry Questionnaire (PSWQ), a widely used measure of trait worry with good psychometric properties (Meyer, Miller, Metzger & Borkovec, 1990).

## Design

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<sup>6</sup>In the present study, the WMIT also included an exploratory component assessing the executive control process of switching (set-shifting). On a small subset of trials (16 trials), stimuli were presented in blue instead of black ink. On these trials, participants completed a slightly different task (press “k” if X is preceded by a letter other than A). The trial that immediately followed each blue trial (i.e., the trial on which the participant switched back to performing the dominant task) was designated a high switching demand trial. However, in the independent validation study, switching performance on the WMIT was not reliably associated with performance on a well-established switching task (Rogers & Monsell, 1995;  $r = -.27$ ). Consequently, blue trials were excluded from analyses and switching data are not presented.



A 2 (worry versus neutral thought; within-subjects) x 2 (Control Thoughts versus No Instruction; between-subjects) x 3 (thought control strategy; between-subjects, Control Thoughts group only) mixed factorial design was used (see Figure 2). All participants engaged in a worry period and a neutral thought period, counterbalanced across participants. Following each thought period, participants in the Control Thoughts group were instructed to control (i.e., stop thinking about) their worried or neutral thoughts using one of three randomly assigned strategies (suppress, distract, reframe) while completing the WMIT. This dual-task design permitted a dynamic assessment of the extent to which WM and inhibition were differentially engaged by attempts to control worry vs. neutral thought. Participants in the “No Instruction” group completed the same two thought inductions but were not instructed to control their thoughts during the subsequent WMIT.

### **Procedure**

Participants were tested individually or in small groups. Participants read a definition and example of a worry topic and a neutral topic and identified one future-oriented, personally relevant topic of each type. Personal relevance was defined as “a topic that has been on your mind recently.”

Participants in the Control Thoughts group next read a brief description of one of three randomly assigned, common thought control strategies: “suppress the thought” (suppression;  $n = 21$ ), “distract yourself from the thought” (distraction;  $n = 24$ ), or “look on the bright side of the thought” (reframing;  $n = 25$ ). Participants were told that they would be asked to control their worried and neutral thoughts using their assigned strategy at a later point in the experiment and were instructed to ask the experimenter if they had

any questions about their assigned strategy. Participants in the No Instruction group ( $n = 30$ ) were instructed to “think about anything” after completing the worry and neutral thought periods (Purdon, 1999).

All participants then learned the WMIT, completed a practice version of the task with and without feedback, and were given another opportunity to ask questions.

Participants next completed the first three-minute thought period. Participants were instructed to think about their chosen worry or neutral topic in the way that they normally think about it, as intensely as possible, until they received further instructions. Immediately after the first thought period, participants rated their state anxiety, then completed 120 trials of the WMIT while controlling their thoughts using their assigned strategy (Control Thought group) or while thinking about anything they chose (No Instruction group). Participants subsequently completed the identical procedure for their other thought topic (worry or neutral). Finally, participants completed the PSWQ prior to debriefing.

## Results

Participants who did not understand the task or follow directions (as evidenced by accuracy  $\leq 3SD$  below the mean) were excluded from data analyses ( $n = 6$ ; 3 each from the Control Thoughts and No Instruction group). Overall accuracy of the remaining participants was high ( $M = 92\%$ ,  $SD = 7\%$ ) and did not differ by group,  $t(93) = -0.36$ ,  $p = .722$ . Error trials, anticipatory responses (RTs less than 150ms), and outlier RTs (RTs  $\geq 3SD$  above or below each participant’s mean RT) were also excluded from analyses.

For each executive control process, accuracy and RT cost scores (e.g., Engle et al., 1995) were computed by subtracting performance in the high demand condition (i.e.,

2-back or f-response) from performance in the low demand condition (i.e., 1-back or k-response). Greater accuracy cost is therefore reflected in a more negative number, whereas greater RT cost is reflected in a more positive number. Separate cost scores were computed for WM and inhibition. These were each computed separately for attempts to control worry and attempts to control neutral thought, resulting in eight cost scores.

### **Preliminary analyses**

Accuracy and RT cost scores did not differ by thought control strategy (all  $F(2, 65) \leq 2.00$ , all  $p \geq .143$ ) or counterbalancing order (all  $t(98) \leq 1.86$ , all  $p \geq .066$ ), nor were any significant interactions observed. Therefore, data were collapsed across assigned strategy (i.e., into one Control Thoughts group and one No Instruction group) and across counterbalancing order for all subsequent analyses.

### **Use of Executive Control by Attempts to Control Worry**

To test the hypothesis that attempts to control worry rely on executive control to a greater extent than do attempts to control neutral thought, paired-samples  $t$ -tests were used to compare WM and inhibition cost during attempts to control worry versus attempts to control neutral thought.<sup>7</sup> Because participants in the No Instruction group were not instructed to control their thoughts, only the Control Thoughts group was included in these analyses. Consistent with the hypothesis, participants experienced greater costs for WM accuracy and inhibition RT during attempts to control worry compared to attempts to control neutral thought (see Table 1), suggesting that attempts to control worry relied more heavily on WM and inhibition than did attempts to control

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<sup>7</sup> An analysis of variance (ANOVA) analysis framework was considered, but was precluded by inadequate statistical power.

neutral thought. By contrast, WM reaction time and inhibition accuracy costs did not differ on the basis of thought type.

To establish whether these differences could be explained by elevated state anxiety during worry, we examined the relationship of state anxiety to WM and inhibition cost during attempts to control worry. As expected, state anxiety was significantly higher following worry ( $M = 67.71$ ,  $SD = 17.35$ ) than neutral thought ( $M = 8.13$ ,  $SD = 15.68$ ),  $t(62) = 22.46$ ,  $p < .001$ ,  $d = 2.83$ . However, state anxiety was not significantly associated with WM accuracy cost,  $r(68) = .07$ ,  $p = .549$ , or with inhibition RT cost,  $r(68) = .10$ ,  $p = .407$ , during attempts to control worry, arguing against elevated state anxiety as the sole explanation for the present findings.

To determine whether WM and inhibition engagement during attempted thought control varied as a function of trait worry, trait worry was correlated with WM accuracy and inhibition RT costs during attempts to control worry and neutral thought. During attempts to control neutral thought, trait worry was not associated with WM accuracy cost ( $r(89) = -.11$ ,  $p = .307$ ) or inhibition RT cost ( $r(89) = .16$ ,  $p = .122$ ). During attempts to control worry, trait worry was marginally associated with both WM accuracy cost ( $r(89) = .19$ ,  $p = .066$ ) and inhibition RT cost ( $r(89) = .20$ ,  $p = .099$ ). Specifically, higher trait worry marginally predicted better WM performance and consequently less engagement of WM during attempts to control worry. Conversely, higher trait worry marginally predicted poorer inhibition performance and consequently greater engagement of inhibition during attempts to control worry. Thus, as trait worry increased, attempts to control worry drew less heavily on WM but more heavily on inhibition.

#### **Attempts to Control Worry versus Residual Effects of Worry**

Independent-samples *t*-tests were used to test the hypothesis that greater WM and inhibition costs during attempts to control worry were attributable specifically to control attempts, rather than to residual depletion effects of worry. Greater costs during worry in the Control Thoughts group (who worried and then controlled thoughts) compared to the No Instruction group (who worried without controlling thoughts) would indicate that the results were not due solely to residual effects of worry. Contrary to our hypothesis, the absolute cost for WM accuracy was not reliably greater in the Control Thoughts group ( $M = -0.04$ ,  $SD = 0.07$ ) than the No Instruction group ( $M = -0.01$ ,  $SD = 0.10$ ) during the post-worry period,  $t(93) = 1.34$ ,  $p = .185$ ,  $d = -0.35$ . The same pattern was observed for inhibition RT: The absolute cost was no greater in the Control Thoughts group ( $M = 105.76$ ,  $SD = 66.91$ ) than the No Instruction group ( $M = 93.04$ ,  $SD = 68.67$ ) following worry,  $t(93) = -0.83$ ,  $p = .409$ ,  $d = 0.19$ . State anxiety did not differ between the groups,  $t(98) = 1.04$ ,  $p = .302$ ,  $d = 0.22$ .

### Discussion

Which executive control processes are engaged when a person tries to stop worrying? The present study examined two promising candidates: WM and inhibition. These processes were assessed while participants attempted to control their worried and neutral thoughts. Participants performed more poorly on measures of WM (accuracy) and inhibition (RT) when trying to control worry than when trying to control neutral thought, suggesting that these processes were especially engaged by attempts to control worry. The extent to which these processes were engaged was not significantly associated with trait worry, nor with level of state anxiety after worrying.

Importantly, participants who attempted to control their worry (Control Thoughts group) did not differ from participants who worried but were not instructed to control their worry (No Instruction group) in the extent to which they engaged WM or inhibition after worrying. This leaves open the possibility that the observed impairments in WM and inhibition are the result of worry itself, rather than of attempts to control worry. This interpretation arguably is also exciting; to our knowledge, no previous research has demonstrated a lasting detrimental effect of worry on WM or inhibition, despite theoretical accounts consistent with a depletion account of worry (Hirsch & Mathews, 2012). If worrying has sustained effects on executive control, it could help to explain the concentration difficulties that characterize GAD. It could also provide new insight into executive control impairments in depression, not only because of possible parallel effects of rumination (Watkins & Brown, 2002), but because of recent evidence that depressed individuals worry as frequently and severely as individuals with GAD in their daily lives (Ruscio et al., under review). Nevertheless, because executive control was not assessed during worry, the present findings cannot distinguish between these competing accounts (i.e., impaired executive control due to depletion by worry, attempts to control worry, or both). Future experimental research that assesses WM and inhibition during worry and during attempts to control worry will be necessary to address this question.

One question that is raised by the present findings is why accuracy (but not RT) was impaired for WM, while RT (but not accuracy) was impaired for inhibition. Although not predicted a priori, this pattern is perhaps unsurprising. Impaired accuracy is a likely consequence of WM failures, which can result in “forgetting.” As RT is based only on accurate trials, unimpaired RT for WM is arguably unsurprising. This assertion

is consistent with research suggesting that accuracy is a more valid measure of WM than RT on the N-back task (the task on which the WM component of the WMIT is based; Miller, Price, Okun, Montijo, & Bowers, 2009). In contrast to WM, successful inhibition requires participants to slow down in order to make the appropriate non-dominant response. This could lead to slower RT but intact accuracy, especially if participants favored accuracy over faster responding. The high overall task performance in the present study (92% accuracy) lends support to this interpretation.

Notably, the present study did not find the predicted interaction between trait and state worry (Hayes et al., 2008). Instead, we observed a marginal effect of trait worry on WM and inhibition engagement during attempts to control worry, such that higher trait worry marginally predicted less engagement of WM and more engagement of inhibition by attempts to control worry. The small size ( $r = .19 - .20$ ) and marginal significance of these effects suggest that it would be premature to draw strong conclusions about the relationship of trait worry to executive control engagement by attempts to control worry. Nevertheless, these findings suggest that the relationship between trait worry and executive control may be more complex than previously assumed.

Why might worry and attempts to control worry rely more heavily on executive control compared to other types of thought? Our findings suggest that this effect cannot be explained solely by state anxiety. Although participants reported higher state anxiety after worry than after neutral thought, anxiety after worry did not predict use of WM or inhibition by attempts to control worry. One possibility is that worry may be more salient than neutral thought, causing disengagement from worry to be more cognitively demanding. In the present study, participants followed the same selection process for

worry and neutral thought topics, nominating a topic that had been on their mind recently. However, it remains possible that participants' worries may have been more vivid, elaborated, or engaging than their neutral thoughts, and correspondingly more difficult to control. Worry has also been described as more verbal-linguistic, repetitive, and negatively valenced than other types of thought (e.g., Borkovec et al., 1983), features that could also contribute to the difficult-to-control nature of worry. Future research investigating the specific features of worry that contribute to its uncontrollability would be a valuable next step.

The present findings—and the questions they raise—highlight several promising directions for future research. Having linked uncontrollable worry to disruptions in WM and inhibition, an important next step is to identify the mechanisms through which controlling worry disproportionately engages WM and inhibition. The identification of such mechanisms could inform the development of interventions designed to target these processes. Another valuable future direction would be to investigate the cognitive processes that are engaged when individuals experience and try to control other types of intrusive, unwanted thoughts (e.g., obsessions, intrusive memories, rumination). By identifying fundamental similarities and differences between these types of thoughts, as well as common processes that may maintain them, this work may set the stage for more potent, efficient interventions for disorders characterized by uncontrollable thought.



Figure 1

A schematic of the Working Memory and Inhibition Task. Working memory is assessed by comparing performance in the 2-back (high demand) vs. 1-back (low demand) conditions. Inhibition is assessed by comparing performance when the correct response is “f” (high demand) vs. “k” (low demand).

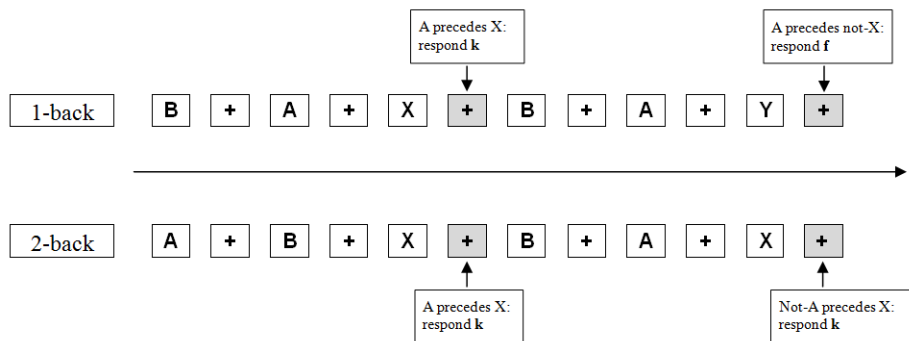


Figure 2

Study design. Red represents tasks completed by the Control Thoughts group. Blue represents tasks completed by the No Instruction group. Purple represents tasks completed by both groups. The order of worry and neutral thought was counterbalanced across subjects. WMIT = Working Memory and Inhibition Task.

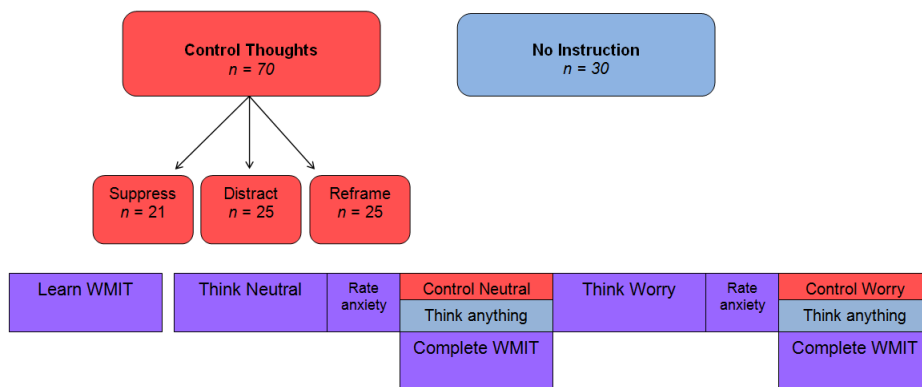


Table 1

*Working Memory and Inhibition Performance during Attempts to Control Worry versus Neutral Thought*

	Attempts to Control Worry			Attempts to Control Neutral			<i>t</i>	<i>p</i>	<i>d</i>
	Low	High	Cost	Low	High	Cost			
	Demand	Demand		Demand	Demand				
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )			
<b>Working memory</b>									
Accuracy	0.94 (0.06)	0.91 (0.11)	-0.04 (0.07)	0.92 (0.12)	0.92 (0.09)	-0.003 (0.11)	-2.14*	0.036	-0.40
RT	322 (91)	337 (91)	15 (60)	308 (94)	320 (99)	12 (58)	0.30	0.760	0.05
<b>Inhibition</b>									
Accuracy	0.95 (0.08)	0.86 (0.11)	-0.08 (0.08)	0.95 (0.93)	0.86 (0.14)	-0.09 (0.14)	0.50	0.620	0.09
RT	301 (83)	407 (109)	107 (67)	290 (94)	377 (103)	90 (65)	2.24*	0.028	0.23

*Note.* RT = reaction time. Due to rounding error, reported costs may differ slightly from costs as calculated using data presented in the table.

All *df* = 66-67.

\* = *p* < .05.

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