Engagement of Cognitive Control and Down-Regulation of Negative Affect

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

ENGAGEMENT OF COGNITIVE CONTROL AND THE DOWN-REGULATION OF NEGATIVE AFFECT

presented by Melanie A. Ramos,

a candidate for the degree of master of arts,

and hereby certify that, in their opinion, it is worthy of acceptance.

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I would like to dedicate this thesis to my family, especially my parents, for their unyielding emotional support in all my endeavors. I would also like to express my gratitude to Gretchen Hendrickson, Julia Martinez, and Christine Maldonado, for their continual optimism and for all the pep talks given during this process. Finally, I would like to thank Philip Buck for his emotional support and patience- I am truly grateful.

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Abstract

Cognitive strategies can be used to regulate emotion. For example, thinking about the specific details of an emotional situation (i.e., specific thinking strategy) decreases negative affect (Philippot et al., 2006). However, exactly how and why this cognitive strategy is effective is still unclear. At the same time, there is indirect evidence for an inverse relationship between cognitive control and emotion. This study examined whether (a) engagement of cognitive control results in decreased negative affect; (b) whether cognitive control is involved in the specific thinking strategy; and (c) whether negative mood also results in poorer cognitive control performance. In this study, negative affect was elicited by having people prepare for public speaking. This study involved four groups: (1) a specific thinking group, expected to exhibit a decrease in negative affect; (2) a cognitive control group (performance of the OSPAN task); (3) an overgeneralized thinking group, which has not been found to be an effective strategy for decreasing negative affect; and (4) a non-emotional control group. Subsequently, all four groups performed another cognitive control task (the Stroop color-naming task). Performance of a second in a series of cognitive control tasks has been found to produce poorer performance (possibly due to resource depletion). The cognitive control group did not have a decrease in negative affect after engaging cognitive control. Further, there was suggestive evidence that the specific thinking group engaged cognitive control, but no evidence to support that engaging cognitive control decreased negative affect. Finally, negative affect was not found to decrease performance on cognitive control tasks. These findings support that cognitive control may not directly decrease negative affect and negative affect may not decrease cognitive control.

Engagement of Cognitive Control and Down-Regulation of Negative Affect

Emotion regulation can be important in a variety of situations, such as when making important decisions, interacting with others, or concentrating on important tasks. People can use a variety of strategies to regulate their mood (Gross, 2002). For example, people can use their behavior to regulate their emotions (e.g. going to see a film to feel better; Carver, Scheier, & Weintraub, 1989). People can also use cognitive strategies to regulate their emotions. Importantly, research has found that cognitive strategies can vary in their effectiveness from in some instances actually being harmful to being helpful (Philippot et al., 2003). For example, engaging in ruminative cognitive activity and repeatedly focusing on negative thoughts has been found to increase risk of depressive episodes (Nolen-Hoeksma, 1993). Conversely, a well-supported treatment for depression is Beck's Cognitive Behavioral Therapy which involves monitoring, identifying, and challenging negative automatic thoughts when emotionally distressed (Beck & Emery, 1976).

The overall goal of this research proposal is to examine what kinds of cognitive activity helps to regulate emotion and to decrease negative affect. In particular, several types of cognitive strategies have been identified that might decrease negative affect. For instance, one apparently successful cognitive strategy is to specifically think about the details of an emotional situation related to negative affect (Philippot et al., 2003; 2006). However, the reasons this strategy might be successful at regulating negative affect are not clear.

A possible explanation for why specific thinking might decrease negative affect is that specific thinking might involve cognitive control, with cognitive control potentially suppressing negative affect (Philippot et al., 2006). Consistent with this, there is indirect evidence from

functional brain imaging that a relationship occurs between the cognitive control and emotion related regions of the brain (Drevets & Raichle, 1998). Based in part on this evidence, a number of cognitive and affective neuroscientists have hypothesized that an inverse relationship exists between brain regions involved in cognitive control and brain regions involved in emotion (Blair, Smith, Mitchell, Morton, Vythilingam, Pessoa, et al. 2007; Drevets & Raichle, 1998; Siegle et al., 2002, 2007). At the same time, there is also evidence that emotion regulation might involve cognitive control (Ochsner & Gross, 2005). However, to our knowledge, no previous study has examined whether engagement of cognitive control by itself results in a decrease of self-reported negative affect.

The current research will examine 3 questions concerning the relationship between cognitive control and regulation of negative affect. The first question is whether engagement of cognitive control decreases negative affect. The second question is whether the specific thinking emotion regulation strategy (Philippot et al., 2006) involves and is mediated by engagement of cognitive control. The third question is whether negative mood results in poorer performance on a cognitive control task. Overall, it is hoped that this research will help clarify the relationship between cognitive control and negative affect and whether cognitive control is involved in emotion regulation.

Cognitive Control

Cognitive control (or executive control) has been defined as the set of processes involved in complex, goal-directed thought and behavior even in the face of interfering information (Botvinick et al., 2001; Dalgleish et al., 2007; Rougier et al., 2005). Although cognitive control involves multiple component processes, one critical component of cognitive control is thought to be the maintenance of goal-relevant or important contextual information (Braver et al., 2007;

Miller & Cohen, 2001; O'Reilly, 2006). For example, imagine while visiting London, England that your goal is to reach a restaurant across a busy street (Miller & Cohen, 2001). Based on previous experience, you might have a strong habit to primarily look left for oncoming traffic. However, in this situation you need to keep in mind the important contextual information that you are in England and must therefore overcome the habit of looking left in order to appropriately look to your right before crossing the street. Another example of cognitive control is a waitperson trying to remember a food order while subsequently taking the orders of 6 other people at the table. Hence, situations involving cognitive control seem to involve the maintenance of important goal or contextual information in order to carry out goal-directed behavior even in the face of conflicting information. Furthermore, although a number of brain regions are involved in cognitive control (O'Reilly, 2006), there are two brain regions thought to be centrally involved in cognitive control. These regions are the dorsolateral prefrontal cortex (PFC) and the dorsal anterior cingulate cortex (ACC; Duncan & Owen, 2000; Kerns et al., 2004; MacDonald et al., 2000; Roelofs et al., 2006).

One frequently used cognitive control task is the Stroop Task (e.g., Cohen et al., 1990; Friedman & Miyake, 2004; Kane & Engle, 2003). In the color-naming Stroop task (MacLeod, 1991; Stroop, 1935), participants are supposed to name the ink color that words are printed in and they are supposed to ignore reading the words. On *incongruent* trials, the ink color is different from the word (e.g., the word "RED" printed in blue ink, with the correct response being blue). Importantly, word reading is highly practiced and occurs relatively automatically (Cohen et al., 1990). Hence, on these incongruent trials, cognitive control is thought to be involved in maintaining goal-relevant information to overcome interference from the word and to appropriately name the ink color (Kane & Engle, 2003). Performance of the color-naming Stroop

task has been consistently found to be associated with performance of other cognitive control tasks (e.g., Cohen et al., 1999; Friedman & Miyake, 2004; Kerns, 2006). Moreover, previous research has consistently found that performance of the Stroop task is associated with activation of the dorsolateral prefrontal cortex and the dorsal anterior cingulate cortex (e.g., Carter et al., 2000; MacDonald et al., 2000). Finally, there is some evidence that performance of the Stroop task is relatively poorer after depletion of cognitive control resources. Specifically, after a period of sustained cognitive control demands, subsequent cognitive control performance on the Stroop task appears to suffer; Gailliot, Plant, Butz & Baumeister, 2007; Schmeichel, 2007).

In addition to the Stroop, another frequently used cognitive control task is the operation span task (OSPAN; Turner and Engle, 1989). On this task, participants read aloud and answer equations (e.g., 2 + 7 – 6 = 3? – answer "true"). After each equation, participants also see a word that they need to memorize. After a set of equations, participants need to recall all of the words that they can remember in order of appearance. Previous research has consistently found that performance of the OSPAN task is strongly associated with other measures of cognitive control (Conway et al., 2005; Engle et al., 1999), including being associated with performance on the Stroop task (Kane & Engle, 2003) and other tasks that involve goal maintenance and suppressing a highly automatic response (Unsworth et al., 2004). Like the Stroop task, the OSPAN is also thought to depend on the ability to maintain a set of task-relevant information in an active state in the face of interfering information (Kane & Engle, 2003; although other cognitive components are also involved in the OSPAN; e.g., Unsworth & Engle, 2007). In addition, like the Stroop task, performance of the OSPAN also is associated with activity in brain regions involved in cognitive control, such as the PFC and the dorsal ACC (Conway et al., 2005). Finally, like the

Stroop task, the OSPAN is also sensitive to cognitive control resource depletion (Gailliot, Plant, Butz, & Baumeister, 2007; Schmeichel, 2007).

Cognitive Strategies for Emotion Regulation

One of the goals of this proposal is to look at the effect of cognitive control on emotion regulation. According to Gross (1998), emotion regulation is how we influence (a) which emotions we have, (b) how we express them, and (c) how we experience them. Cognition is also involved in emotion regulation. For example, one cognitive strategy that appears to be effective in regulating negative emotions is cognitive reappraisal (Gross, 2002). Cognitive reappraisal involves changing the way one thinks about a potentially emotional situation (John & Gross, 2004), for example, if a person presents a business idea that is criticized and rejected, it can be viewed as a failure or an opportunity to learn how to improve that idea. This strategy has been associated with increased positive and decreased negative affect (John & Gross, 2004).

Philippot et al. (2003, 2006) identified another potentially effective cognitive strategy for regulating emotion, which I will refer to as the *specific thinking strategy*. For this strategy, participants are asked questions that progressively specify in greater detail their worries about public speaking (Philippot et al., 2006). These specific thinking questions, which are provided in Appendix A, relate to the emotions felt for that situation, how these emotions are related to bodily sensations and what behaviors the participants predict would occur from these emotions. For example, if the researcher asked the participants, “What emotion predominates and why?”, the participant might respond by naming their emotion (“shame”). The participant would then speak about why they would feel shameful (“I’d feel shameful because then everyone would know that I’m worse at this than everyone else”). A further example would be a response to the

statement “Can you concentrate on the behaviors and reactions that would be triggered by your fears”. The participant may then describe focusing on sweating, nausea, or an inability to sit still.

Philippot et al. (2003, 2006) found evidence to support that thinking specifically about a negative experience was effective at decreasing the intensity of an emotion. In their studies, participants were induced with anxiety and assigned to use the specific thinking strategy or an overgeneralization strategy. Participants in the overgeneralization condition were asked questions to focus their thoughts on aspects of the emotion inducing situation that could be details of any anxiety-provoking situations (e.g. “Think about a color that you associate with this state” or “Think about the spontaneous reaction that you have in this situation”. Philippot et al. (2006) found that participants in the specific thinking condition had decreased their anxiety while those in the overgeneralization condition did not (Philippot et al., 2006). Philippot et al. (2006) also found that these specific thoughts needed to be related to the emotions currently experienced and not non-emotional or generic details of the situation.

Though the specific thinking strategy is effective at decreasing negative affect, in contrast, people actually tend to believe the opposite is true (Philippot et al. 2006). Philippot et al. (2006) found that both healthy and socially phobic participants believed that thinking specifically about the details of a negative experience would lead to greater intensity of the emotion. Instead, as previously mentioned, Philippot et al. (2006) found that the opposite was supported, that specific thinking about a negative experience decreased the intensity of the emotion. Thus, people’s perception of the influence of their cognitions on emotion may affect their choice in emotion regulation strategies (Philippot, Baeyens, & Douilliez, 2006).

Thus, although it is contrary to people’s beliefs, there is evidence to support that specific thinking *is* an effective emotion regulation strategy. However, it is still unclear *why* this strategy

is effective. One explanation for the effectiveness of specific thinking was that this strategy involved cognitive reappraisal (Philippot et al., 2006). In order to distinguish the specific thinking strategy from reappraisal, Philippot et al. (2006) induced anxiety in participants and assigned them to either a cognitive reappraisal condition or a specific thinking condition. In the specific thinking condition, Philippot et al. (2006) removed any content from the specific thinking questions that was related to cognitive reappraisal. The authors found that the specific thinking strategy was effective at decreasing anxiety even though questions related to cognitive reappraisal were removed (Philippot et al., 2006). Thus, the specific thinking strategy was hypothesized not to rely on cognitive reappraisal to be effective.

Instead of cognitive reappraisal, an alternative explanation for why specific thinking decreased the intensity of an emotion is that it involves cognitive control (Philippot et al., 2006). Again, one critical component of cognitive control is goal maintenance in order to overcome automatic prepotent thoughts and behaviors. Importantly, the experience of intense emotions seems to involve automatic thoughts and behaviors. For example, it is thought that emotions involve the activation of action tendencies, with part of the adaptiveness of emotions being related to their priming of certain behaviors (Frijda, 2004). Along similar lines, strong emotions could influence cognitive strategies, such as anxiety inducing an attentional bias to search for threatening cues (MacLeod et al., 2002). Furthermore, emotions might tend to activate certain types of cognitive content, such as anxiety inducing worry about upcoming events (Borkovec et al., 1996). Hence, strong emotions such as anxiety might involve highly automatic prepotent thoughts and behaviors. To suppress and overcome these automatic thoughts and behavior might require cognitive control. Therefore, the specific thinking strategy might involve cognitive control as people might need to suppress emotional automatic thoughts and behaviors in order to

reach the goal of answering specific questions about their current thoughts and feelings. Specific thinking might then be an effective emotion regulation strategy because suppression of emotional thoughts and feelings might result in decreased negative affect. If true, this suggests that engagement of cognitive control might be an effective strategy to down-regulate negative affect.

If cognitive control does result in decreasing negative affect, this may have several important implications for understanding emotion regulation. On the one hand, this might suggest that engagement of cognitive control could be an effective emotion regulation strategy that could be utilized to decrease people's emotional distress. At the same time, it might also have some implications for understanding other emotion regulation strategies. If engagement of cognitive control results in decreased negative affect, then potentially cognitive control could partly account for the effectiveness of some other emotion regulation strategies. Furthermore, if cognitive control is found to directly decrease negative affect, it might have implications for some types of psychopathology that involve emotion dysregulation (e.g. Borderline Personality Disorder and Major Depressive Disorder). Therefore, in the current study, I will examine whether engagement in cognitive control results in a decrease in negative affect.

The Relationship between Cognitive Control and Emotion Regulation

To my knowledge, I am not aware of work that has directly examined the effect of cognitive control engagement on emotion regulation. However, some previous research has provided indirect evidence for an effect of cognitive control on mood. For instance, a common observation of functional brain imaging studies is an apparent inverse association between the brain regions involved in cognitive control and brain regions involved in emotion. As mentioned in an early review of imaging studies by Drevets and Raichle (1998), when emotion areas of the brain (e.g. the amygdala and orbital prefrontal cortex (OFC)) are active, cognitive control areas

(the prefrontal cortex (PFC) and the dorsal anterior cingulate cortex (ACC)) tend to be deactivated, and vice versa. A similar relationship between emotion and cognitive control regions has also been noted within subdivisions of the ACC (Bush, Luu & Posner, 2000). More recent imaging research has continued to note an inverse association between cognitive control and emotion regions of the brain (Blair et al. 2007; Siegle et al., 2002, 2007).

In addition, Siegle et al, (2002, 2007) has found evidence suggesting that sustained activation of emotion regions and concomitant decreased activation of cognitive control regions might be involved in depression. Specifically, they have found that when performance of a cognitive control task follows emotion elicitation that control participants exhibit a significant inverse relationship between increased dorsolateral PFC activity and decreased amygdala activity. In contrast, depressed individuals continue to exhibit sustained amgydala activity without an association between dorsolateral PFC activity and amygdala activity. It has been hypothesized that decreased suppression of emotion regions by cognitive control regions in depression may be related to some features of depression such as rumination (Siegle et al., 2007; Sackeim & Steif, 1988). Thus, there is indirect brain imaging evidence supporting an inverse relationship between regions involved in cognitive control and regions involved in emotion.

In addition to brain imaging studies suggesting an inverse relationship between cognitive control and emotion, other research suggests that emotion regulation engages cognitive control. For example, Ochsner et al. (2004) investigated the effects of voluntarily increasing or decreasing negative affect. Participants in this study viewed affect-inducing pictures and were instructed to use cognitive strategies to either increase or decrease their affect. Ochsner et al. (2004) found that the emotion regulation strategies used for increasing or decreasing affect were effective and were associated with activation of the dorsolateral PFC. Moreover, other fMRI

studies of emotion regulation have also found prefrontal activation during emotion regulation (Johnstone et al., 2007). Thus, the activation of the dorsolateral PFC implicates the use of cognitive control processes in these emotion regulation strategies.

Another study suggesting that cognitive control is involved in emotion regulation examined the effect of emotion regulation on cognitive control resource depletion (Schmeichel, 2007). As previously mentioned, cognitive control processing is hypothesized to be a limited resource, (with a refractory period after previous use; Gailliot, Plant, Butz and Baumeister, 2007). Schmeichel (2007) hypothesized that when faced with an emotion eliciting stimuli (a gruesome film clip), performing a cognitively demanding task (OSPAN) would lead to difficulty in inhibiting one's emotional response. Schmeichel (2007) found that after watching the emotion eliciting film clip, participants who completed the cognitively demanding task exhibited more facial response to a second emotion eliciting clip in comparison to participants who did not perform the cognitive task. Schmeichel (2007) posited that the emotion eliciting stimuli provided enough cognitive demand to deplete cognitive resources (Schmeichel, 2007). This finding further suggests that cognitive control might be involved in emotion regulation.

Furthermore, as previously discussed, cognitive control and emotion are inversely associated, suggesting that cognitive control could decrease negative affect. However, this also suggests that the opposite could be true, that increased negative affect could decrease cognitive control. There is some evidence that prolonged negative affect and stress might decrease cognitive control performance. For example, Klein & Boals (2001a) found that cognitive control performance was related to current stress levels and that disclosure of a traumatic event resulted in improvement in cognitive control ability seven weeks later (Klein & Boals, 2001b). Other research has found that fear (threat or actual delivery of shock) caused poorer performance on a

non-verbal cognitive control task (but not on a verbal one; Shackman et al., 2006). Finally, it has been found that briefly elicited negative affect (presentation of negative IAPS slides) causes poorer performance on cognitive control tasks involving suppressing habitual responses (e.g., the Stroop; Becker & Kerns, unpublished data). Hence, there is some evidence that negative emotion might result in poorer cognitive control, however evidence for this is still limited. Finding a direct relationship between negative affect and cognitive control tasks may have implications for understanding normal and impaired emotion regulation. For example, if cognitive control is important for emotion regulation, then poorer cognitive control with concomitant negative affect might make emotion regulation even more challenging. In the current study I will examine whether an increase in negative mood causes poor performance in tasks requiring cognitive control.

Unanswered Questions about Cognitive Control and Emotion Regulation

Based on this literature review of cognitive control's involvement in emotion regulation, it appears that there is some support for an inverse relationship between cognitive control and emotion related regions of the brain. Further, this review also suggests that cognitive control may be involved in emotion regulation and in decreasing negative affect. However, there are several important unanswered questions about the relationship between cognitive control and emotion. One unanswered question about cognitive control and emotion is whether engagement of cognitive control processes actually produces a decrease in negative affect. Although previous imaging studies provide indirect evidence for a possible effect of cognitive control on emotion regulation, to my knowledge I am unaware of any study that has examined whether engagement of cognitive control causes a decrease in self-reported negative affect.

A second unanswered question about cognitive control and emotion is whether engagement of cognitive control is involved in the specific thinking strategy. Philippot et al. (2006) found that specific thinking significantly decreased negative affect. However, it is unclear why the specific thinking strategy decreases negative affect. One possibility is that the specific thinking strategy involves the engagement of cognitive control.

A third unanswered question about cognitive control and emotion is whether increased negative affect causes poorer performance on cognitive control tasks. There is some limited evidence that increased negative affect does result in poorer cognitive control. If cognitive control is important for emotion regulation, then poorer cognitive control in the face of emotion elicitation could have important implications for emotion regulation.

Current Study

Thus, in this proposal I will investigate three questions regarding cognitive control and emotion regulation: a) whether engagement of cognitive control results in decreased negative affect, b) if cognitive control is involved in the specific thinking strategy and whether cognitive control engagement is related to the effectiveness of the specific thinking strategy, and c) if negative mood results in poor cognitive control. This experiment will involve 4 groups of participants: (1) a specific thinking group, (2) an overgeneralized group, (3) a cognitive control group, and (4) a non-emotional control group. Of these 4 groups, the first 3 groups will undergo a negative mood induction and will be randomly assigned to 1 of 3 emotion regulation conditions. The fourth group, the non-emotional control group, will not undergo a negative mood induction and will not involve emotion regulation (instead, this group will watch a neutral film clip). Subsequent to carrying out emotion regulation (or watching a film clip), all groups will

complete a cognitive control task (the Stroop task) which will be referred to as the secondary cognitive control task.

To examine whether engagement of cognitive control results in decreased negative affect, the cognitive control group will be compared to the overgeneralized group. After a negative mood induction, the cognitive control group will perform a challenging cognitive control task, the OSPAN. If engagement of cognitive control results in decreased negative affect, then the cognitive control group should report decreased negative affect after performing a cognitive control task. Based on results of Philippot et al (2006), the overgeneralized group is not expected to exhibit a decrease in negative affect after emotion regulation. Therefore, if cognitive control results in decreased negative affect, then the cognitive control group should exhibit decreased negative affect compared to the overgeneralized group.

In addition, in the current study to examine if cognitive control is involved in the specific thinking strategy and whether cognitive control engagement is related to the effectiveness of the specific thinking strategy, I will examine how well the specific thinking group performs on a cognitive control task after emotion regulation. As previously mentioned, after engagement of cognitive control, participants tend to exhibit resource depletion and perform worse on a cognitive control task. If the specific thinking strategy involves engagement of cognitive control, then after carrying out that strategy people in the specific thinking group should perform less well on the Stroop task compared to people in the overgeneralized group and compared to people in the non-emotional control group. Furthermore, if cognitive control engagement is related to successful emotion regulation in the specific thinking group, then in the specific thinking group poorer Stroop task performance (i.e., greater resource depletion after emotion regulation) should be related to a larger decrease in negative affect.

Finally, in the current study to examine if negative mood results in poor cognitive control, the overgeneralized group will be compared to the non-emotional control group in Stroop task performance. Again, based on the results of Philippot et al. (2003, 2006), the overgeneralized group is expected to exhibit increased negative affect after emotion regulation. If increased negative affect disrupts cognitive control performance, then the overgeneralized group should do less well on a cognitive control task than the non-emotional control group who will be in a neutral mood.

Method

Participants

As can be seen in Table 1, participants were 145 undergraduate students (75 students were female), 18-26 years of age, from an Introductory Psychology course at the University of Missouri- Columbia. In exchange for participating in this study, each participant received research credit hours.

Measures

Demographic Questionnaire. A brief questionnaire was administered to gather information on age, gender, education level, and ethnic background.

Mood measure. To measure mood, participants completed the state scale of the State Trait Anxiety Inventory (STAI; Spielberger, 1986). The STAI has a range of 4 responses (1= Not at all to 4= Very much so) to 20 items. In order to replicate the procedure used by Phillipot et al. (2006), I used this inventory to measure the participants' state anxiety levels at 4 time points: a) after the demographic questionnaire but before the negative mood induction, b) after the negative mood induction, c) subsequent to the mental training tasks, and d) after the secondary cognitive control task.

Blindness Rating Scale. To assess whether participants were aware of the function of the mood, at the end of the study participants were asked if they suspected that they would not be presenting a speech. If they said yes, they were asked two follow-up questions: (a) when they realized there was not going to be a speech given; and (b) the percent to which they believed they were not going to give a speech (0% have to give a speech, 100% sure no speech was involved). A blindness rating from 1 to 7 was assigned

Table 1

Descriptive Statistics for Demographic Variables

	Group			
Variables	Cognitive Control	Specific Thinking	Overgeneralized Thinking	Non-emotional Control
N	29	37	41	38
Age	19.28 (1.13)	19.54 (1.79)	19.00 (0.80)	18.97 (0.94)
Gender				
% Female	51.7	64.9	48.8	57.9
Ethnicity				
% Caucasian	93.10	86.50	75.60	86.80
Education Level				
% Freshman	69.0	70.3	78.0	71.1
% Sophomore	17.2	10.8	12.2	21.1
% Junior	6.9	4.4	9.8	5.3
% Senior	6.9	13.5	0.0	2.6
GPA(cumulative)	3.16 (0.10)	3.08 (0.12)	3.06 (0.10)	3.10 (0.08)
English First Language				
% Yes	100.0	97.3	92.7	94.7

for each question based on the participants' answers. As can be seen in Table 2, some participants did report suspecting that they might not have to give a speech. In exploratory analyses, I examined whether these measures of lack of blindness to the experimental manipulation was related to post-mood induction anxiety levels or to changes in anxiety levels after mental training. I also examined whether eliminating the participants who were least blind would reveal between-group differences in the effects of mental training. However, the blindness ratings were unrelated to anxiety and removing participants who were not blind (including removing all participants who had doubts by the end of mental training) did not change the results.

International Personality Item Pool. The neuroticism and extroversion items of the International Personality Item Pool (IPIP) were administered to subjects as a neutral task. This task was completed before the mood induction and consisted of a 40 item survey. Subjects responded to each question with one of 5 responses: a) very inaccurate, b) moderately inaccurate, c) neither accurate or inaccurate, d) moderately accurate, or e) very accurate.

Stroop task. The Stroop task (Stroop, 1935) was administered following the mental training condition. As previously described, in this task, participants are supposed to name the ink color words are printed in and are supposed to ignore reading the words. The Stroop task was chosen as it has been consistently found to be associated with the performance of other cognitive control tasks (e.g., Cohen et al., 1999; Friedman & Miyake, 2004; Kerns, 2006). Further, the Stroop task has been previously used in studies investigating cognitive control resource depletion (Gailliot, Plant, Butz and Baumeister, 2007).Following the procedure used by Kerns (2006), participants were presented with a

Table 2

Focused Contrasts of Between Group Comparisons

Group Comparisons of Effects on Anxiety

	Conditions			
Contrasts	Cognitive	Specific	Overgeneralized	Control
		Anxiety		
1	-1	-1	-1	3
2	-1	0	+1	0
3	0	-1	+1	0
		Stroop Performance		
4	-1	-1	+1	+1
5	0	2	-1	-1
6	0	0	+1	-1

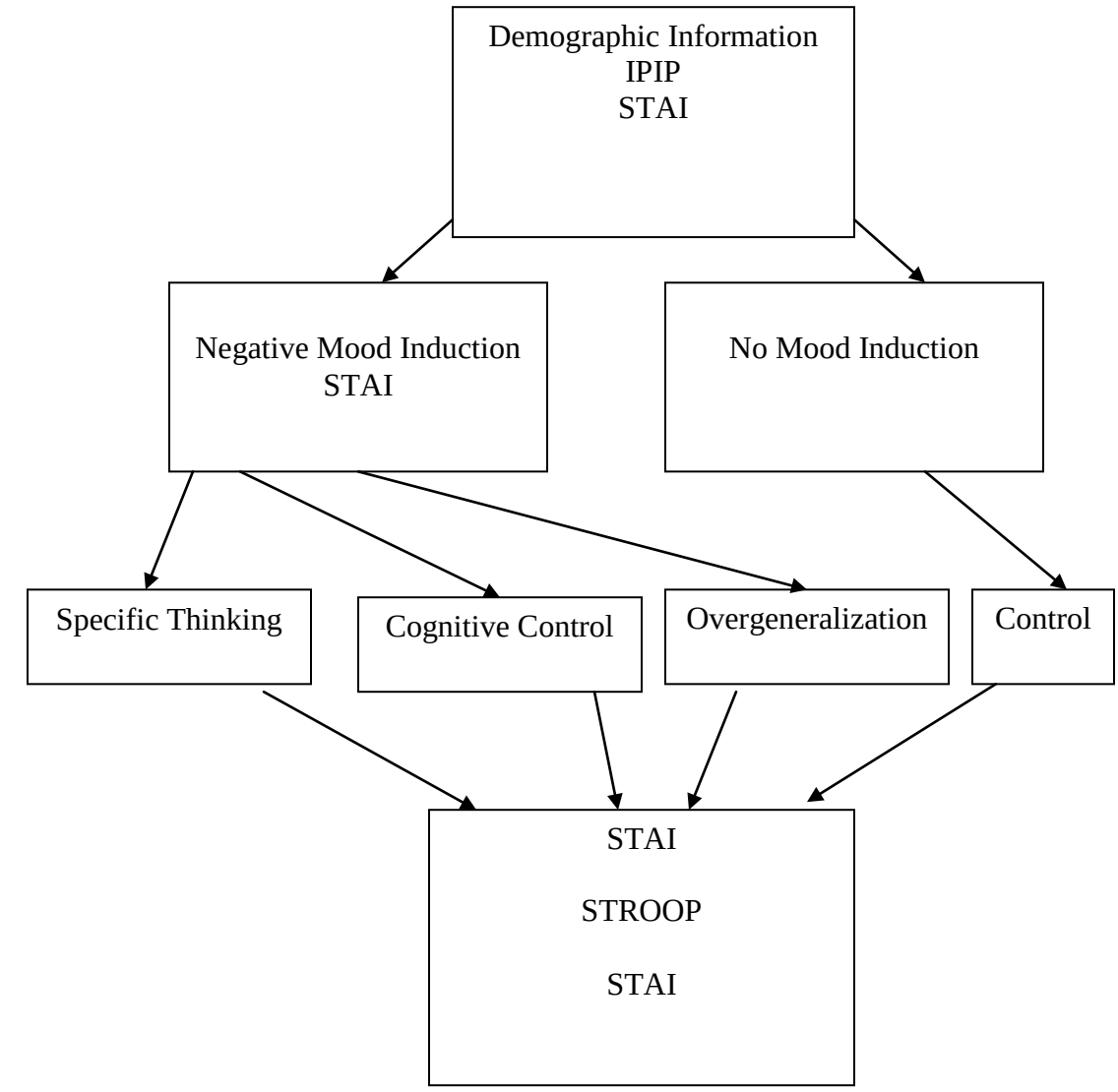
series of color words (e.g. blue, red, green and yellow) on a computer screen. On each trial, a color word was presented in either a print color congruent with the read word (e.g., “blue” written in blue print) or an incongruent print color (e.g., “blue” written in red print). Participants pressed “1” for red, “2” for green, “3” for blue or “4” for yellow, on the computer keyboard depending on the color of the printed word (i.e., not the word that is read) and received feedback if an error was made. Performance on this task was measured by the participants’ reaction time difference between congruent and incongruent trials.

Procedure

Randomization. Prior to individuals participating in the study, a random number generator was used to place participants into one of the four groups. This randomization was completed separately for each gender to maintain an equal number of males and females in each group. Unfortunately, as can be seen in Table 1, the number of participants was uneven as block randomization was not used. Once the participant arrived, a participant number was given and the individual completed the consent form, the demographic questionnaire and the first (of four) mood measure (see Figure 1 for an outline of the full procedure and Appendices A-D for outlines of each procedure).

Mood induction. Similar to the procedure used by Philippot et al. (2006), participants in the specific thinking, the cognitive control, and the overgeneralization groups were told that they were to give an oral presentation related to an international news topic. Participants were told that they were to give a speech in front of a video camera and scored for their public speaking ability. Finally, participants were told that their presentation topic is the economic threat of a vegetation eating bacteria in Australia.

Figure 1. *Summary of Study Procedure*



After mood induction but before engaging in emotion regulation, participants completed a second mood measure.

Participants in the non-emotional control condition were not told that they were to give an oral presentation. Instead, these participants were told that they would watch a video of a person giving a speech. As can be seen in Figure 1, before watching the video the non-emotional control group was inadvertently not given the STAI (i.e., they were not given a Time 2 mood measure). Any analyses involving time 2 mood did not include this group. As can be seen in Table 4, the non-emotional control group exhibited no change in mood between Time 1 and Time 3.

Emotion Regulation. Participants in the specific thinking, the cognitive control, and the overgeneralization groups were told that before their oral presentation that they would be given 10 minutes in which to relax and complete 'mental training' to help the participant cope with stress. Participants in the specific thinking condition were read questions that required increasingly more detail about the participants' current emotions and the emotion provoking situation (for a summary of this procedure refer to Appendix A). The script for this condition was created based on the procedure used by Philippot et al. (see Appendix E) and the questions were taken from the specific thinking condition task used in Philippot et al.'s (2006) study. One sentence per minute was read.

Participants in the cognitive control condition were given a computerized working memory task that involved a high level of cognitive control demand (for a summary of the procedure for the cognitive control group refer to Appendix B). The Operation Span Task (OSPAN; Turner and Engle, 1989; Engle et al., 1992) was used and included both processing of a mathematical equation and recall of a word. Similar to the procedure used

by Schmeichel (2006), participants read an equation out loud requiring two operations (e.g. (2 + 3) – 1 = 6) and indicated either “yes” if the equation is correct, or “no” if the equation is incorrect on the keyboard. This equation was followed by a one syllable word (e.g. train, house, and web) which the participant read and remembered for later recall. After several items, the participant was asked to recall all the words they had seen and was required to vocally list their recalled words. The number of equation-word pairs seen before the participant was asked to recall the words varied between 3 and 7. Varying the number of equation-word pairs seen before recall prevented the participants from anticipating the number of words they must remember, thus decreasing the use of rehearsal strategies. Rehearsal strategies decreased the use of executive control processes in previous studies, and were minimized in this study (Conway et al., 2005). The OSPAN is derived from another span task called the reading span task (Daneman & Carpenter, 1980). One advantage of using the OSPAN rather than the reading span task is that the reading span task is thought to be dependent on non-cognitive control abilities (i.e., reading comprehension; Conway et al., 2005). The OSPAN task has been shown to have high reliability and to be associated with other measures of cognitive control such as the Stroop (Kane & Engle, 2003). The script for this condition was based on the procedure from Engle, Cantor, and Carullo (1992; for the script details please see Appendix F).

Participants in the overgeneralized thinking condition were asked questions to focus their thoughts on general aspects of the emotional situation (see Appendix C for a summary of the procedure for the overgeneralized group). The script for this study was based on Philippot et al.’s (2006) description of their presentation of the condition to their participants (for further detail, please refer to Appendix G). In addition, the questions

used for the overgeneralized thinking condition are those used by Philippot et al. (2006). The researcher read one sentence per minute.

Participants in the non-emotional control group did not perform any emotion regulation task since they did not receive a mood induction (for a full summary of the control procedure refer to Appendix D). Instead, participants in this group watched a 10 minute film clip of someone giving a speech (see Appendix H for a detailed script). This condition was designed not to activate cognitive control and to keep participants in a neutral mood.

Final Cognitive Control Task. Following the mental training task, participants were given the third mood measure. Participants were then given the final cognitive control task, the Stroop task, and were immediately given the fourth mood measure. Subsequently, the participants were told they would not be giving a speech, were asked the blindness assessment questions, and spent 5 minutes completing a positive mood induction using the same instructions as Larsen & Ketelaar (1991). Participants were then debriefed as to the actual intent of the study. The experimenter answered any questions or concerns of the participants and then thanked them for their participation.

Data Analysis. A one-way repeated measures ANOVA was conducted to examine the effect of mental training conditions on level of anxiety. In addition, focused contrasts were conducted to examine the effects of each condition on anxiety (see Table 2). To examine whether the non-emotional control group differs from the groups receiving the negative mood induction, the control group was compared to the other 3 groups (contrast 1). To examine whether activating cognitive control processes themselves decrease negative affect, a specific contrast was conducted between the cognitive control group

and the overgeneralized thinking group (contrast 2). Finally, to examine whether the specific thinking group decreases negative affect, a contrast was conducted between the specific thinking group and the overgeneralized thinking group (contrast 3). A one-way ANOVA was also conducted to examine cognitive control resource depletion in each group. Focused contrasts were also conducted between groups for this analysis (see Table 2). Specifically, to examine whether cognitive control processes were involved in the specific thinking and cognitive control conditions, these two groups were compared to the overgeneralized thinking group and the non-emotional control group (contrast 4). Further, if the specific thinking group did have cognitive control resource depletion, it should differ from the overgeneralized thinking group and non-emotional control group (contrast 5). Finally, to examine if negative mood is associated with poorer cognitive control performance, the overgeneralized thinking group was compared with the non-emotional control group (contrast 6).

The magnitude of the effect sizes were calculated for the chi square, ANOVA, and t-test analyses. The cut-off values for each test of effect size were based on Cohen (1992). For the chi square analyses, the magnitude of the effect size was measured using Cramer's *V*, where; for $df = 3$, $V = 0.06$ to 0.17 was a small effect, $V = 0.18$ to 0.29 was a medium effect, and $V = 0.30$ and greater was a large effect. The magnitude of the effect size of the ANOVA analyses were measured using η^2, where $\eta^2 = 0.01$ was a small effect size, $\eta^2 = 0.09$ was a medium effect size, and $\eta^2 = 0.25$ is a large effect size. Finally, Cohen's *d* was used to calculate the magnitude of the effect size for t-tests, where $d = 0.20$ was considered a small effect, $d = 0.50$ was a medium effect and $d = 0.80$ was a large effect size.

Results

Demographic characteristics. First, I examined whether there were any between-group differences on demographic characteristics. As can be seen in Table 1, there were no significant between-group differences in age, F (3, 141) = 1.37, p = 0.26, η^2 = 0.01 (small effect); level of education, χ^2 (9, N = 145) = 9.89, p = 0.36, V = 0.09 (small effect size); gender, χ^2 (3, N = 145) = 2.32, p = 0.51, V = 0.07 (small effect size), English as a primary language χ^2 (3, N = 145) = 2.61, p = 0.46, V = 0.08 (small effect size), or ethnicity, χ^2 (3, N = 145) = 4.45, p = 0.22, V = 0.10 (small effect size). However, as can be seen in Table 1, there was a trend for a significant difference between the overgeneralized and the cognitive control groups in percentage of Caucasian participants, χ^2 (1, N = 70) = 3.66, p = 0.06, V = 0.22 (medium effect size). To examine whether this had an effect on any results, we re-ran all analyses using only Caucasian participants and the results were virtually identical.

Blindness ratings. Next, it was examined whether there were any within-group or between-group differences in blindness to the mood induction (see Table 3). To explore this, we analyzed both blindness rating questions separately and together in comparison to anxiety at time 2, to the difference between time 2 and time 3 anxiety, and Stroop performance using Pearson correlations. In all instances the results did not show decreased anxiety, all $p > 0.05$, thus, I included all participants in the analyses.

Mood manipulation check. Next, it was examined whether there were any between-group differences in baseline mood. As can be seen in Table 4, there were no significant differences between the four groups in baseline anxiety, F (3, 141) = 0.74, p =

Table 3.

Group Percentages of Blindness Ratings

		Group			
	Blindness Rating	Specific Thinking	Over-generalized	Cognitive Control	Non-emotional control
When Suspicious	Very Beginning	8.1	4.9	0	0
	After Topic Given	21.6	26.8	13.8	0
	After Mental Training	5.4	4.9	6.9	0
	Between Training & Stroop	2.7	2.4	0	0
	During Stroop	16.2	9.8	17.2	0
	After Stroop	5.4	4.9	3.4	0
	Not Suspicious at all	40.5	46.3	55.2	100
% Chance No Speech	100% Chance	0	0	0	0
	>80% Chance	16.2	24.4	3.4	0
	>65% Chance	10.8	7.3	6.9	0
	>50% Chance	10.8	12.2	13.8	0
	>35% Chance	10.8	4.9	10.3	0
	>20% Chance	10.8	4.9	6.9	0
	0% Chance	40.5	46.3	55.2	7

Table 4

Means and Standard Deviations for Anxiety at Different Time Points

Group	Time Point			
	Baseline (T1)	Post-Mood Induction (T2)	Post-Mental Training (T3)	Post-Stroop Task (T4)
Cognitive Control	33.86(8.83)	49.14(13.87)	48.21(14.83)	47.18(14.22)
Specific Thinking	34.03(8.68)	47.03(12.84)	47.00(13.06)	43.32(11.13)
Overgeneralized Thinking	33.41(7.37)	49.20(13.91)	48.29(14.99)	46.66(12.66)
Non-emotional Control	31.61(7.06)	-	31.63(1.20)	34.39(8.15)

0.53, $\eta^2 < 0.01$ (very small effect). Next, I examined whether the mood induction increased anxiety. As can be seen in Table 4, in a 3 (group: cognitive control vs. specific thinking vs. overgeneralized thinking) X 2 [time point: baseline (T1) vs. post-mood induction (T2)] repeated measures ANOVA, there was a significant main effect of time, F (1,103) = 100.81, $p < 0.01$, $\eta^2 = 0.49$ (large effect), as anxiety was significantly higher after mood induction than at baseline. However, the main effect of group, F (2, 103) = 0.10, $p = 0.90$, $\eta^2 < 0.01$ (very small effect) and the interaction between time and group, F (2, 103) = 0.56, $p = 0.58$, $\eta^2 < 0.01$ (very small effect), were not significant. Using specific contrast 1, a significant difference was found between the non-emotional control group compared to the specific thinking, cognitive control, and overgeneralized thinking group, t (140) = 7.64, $p < 0.01$, $d = 1.29$. Hence, it appeared that the mood induction resulted in a similar increase in anxiety in all three groups (again, results were identical when we excluded participants who were least blind to the manipulation; e.g., for main effect of group and the time X group interaction, p's > 0.63) and the non-emotional control group differed from those receiving the mood induction.

Hypothesis 1: Engaging cognitive control decreases negative affect. Next, it was examined whether the mental training tasks decreased negative affect and whether there were differences between the training tasks in decreasing negative affect (e.g., whether the cognitive control group exhibited a larger decrease in anxiety than the overgeneralized thinking group). As can seen in Table 4, in a 2 [time point: post-mood induction (T2) vs. post-mental training task (T3)] X 3 (group: cognitive control, specific thinking, and overgeneralized thinking) repeated measures ANOVA, the effect of time, F (1,103) = 0.87, $p = 0.36$, $\eta^2 < 0.01$ (very small effect), the effect of group, F (2,103) =

0.19, $p = 0.83$, $\eta^2 < 0.01$ (very small effect), and the interaction between time and group, F (2,103) = 0.21, $p = 0.81$, $\eta^2 < 0.01$ (very small effect), were all not significant. Further, for specific contrast 2, no significant difference was found when comparing the cognitive control group to the overgeneralized thinking group, t (140) = -0.02, $p = 0.99$, $d < 0.01$. Hence, it appears that none of the groups exhibited a significant decrease in anxiety after mental training (again, results were virtually identical when we excluded participants who were least blind to the manipulation, p's > 0.62).

Associations between cognitive control mental training task and anxiety. If engaging cognitive control reduces negative affect, then performance on the cognitive control mental training task (i.e., the OSPAN) should be associated with decreased anxiety. To examine this, I examined whether OSPAN performance (see Table 5) was associated with anxiety levels after mood induction (T2), with anxiety levels after performing the OSPAN (T3), and with the change in anxiety level between T2 and T3. Results were that none of these associations were significant, with T2, $r = 0.01$, with T3, $r = 0.07$, and the difference between T2 and T3, $r = -0.08$. Hence, it did not appear that OSPAN performance was associated with anxiety levels or with changes in anxiety.

Hypothesis 2a: The specific thinking strategy involves engaging cognitive control. If specific thinking strategy involves engagement of cognitive control, then it was predicted that people in the specific thinking group would perform less well on the secondary cognitive control task (the Stroop task) than the non-emotional control group. In addition, given that the OSPAN task also involves cognitive control, then it was expected that people in the cognitive control (OSPAN) group would also perform less well on the secondary cognitive control task. As can be seen in Table 4, in a one way

Table 5

Means and Standard Deviations of Stroop Effect by Group

	Group			
Stroop Effect	Cognitive Control N = 28	Specific Thinking N = 36	Overgeneralized Thinking N = 41	Non-emotional Control N = 37
Error Rate	0.13 (0.09)	0.12 (0.09)	0.12 (0.09)	0.09 (0.07)
Reaction Time (ms)	306.10 (172.85)	281.31 (179.32)	243.33 (113.18)	243.56 (140.62)
Combined Stroop	153.11 (86.43)	140.71 (89.67)	121.72 (56.59)	121.83 (70.31)

between groups ANOVA for Stroop task performance, there was no significant main effect of group, F (3, 139) = 1.80, p = 0.15. When we compared the specific thinking group and the non-emotional control group on Stroop task performance, there was no significant difference between groups, t (71) = 1.43, p = 0.16, although numerically the specific thinking group did appear to exhibit poorer performance than the non-emotional control group. For specific contrast 3, where the specific thinking group was compared to the overgeneralized group, there was also no significant difference between groups, t (141) = 1.14, p = 0.26, d = 0.32. However, the cognitive control (OSPAN) group did perform significantly less well than the non-emotional control group on the Stroop task, t (63) = 2.17, $p < .05$. In contrast, there were no significant differences in Stroop performance for the specific thinking and the cognitive control groups, t (62) = 0.63, p = 0.53. For specific contrast 4, I compared the specific thinking and cognitive control groups to the overgeneralized and non-emotional control groups. The result of this contrast approached significance difference, t (139) = -1.89, p = 0.06, d = -0.32. Therefore, there is suggestive but inconclusive evidence that the specific thinking group performed less well on the Stroop task than the non-emotional control group.

Hypothesis 2b: Engaging cognitive control is related to decreased anxiety levels. If changes in anxiety within the specific thinking group were related to engagement of cognitive control, then it was predicted that any decreases in anxiety would be related to their Stroop task performance. To examine this, I examined associations between Stroop task performance and post-mood induction (T2) and post-mental training task (T3) anxiety levels. For the specific thinking group, the associations between Stroop task performance and anxiety levels were not significant: for T2 anxiety, r = -0.17, p = 0.32,

for T3 anxiety, r = -0.18, p = 0.31, and for the difference between T2 and T3 anxiety, r = 0.01, p = 0.95. For specific contrast 5, where the specific thinking group was compared to the overgeneralized and non-emotional group, a significant difference was not found, t (139) = 1.24, p = 0.22, d = 0.21. Hence, it did not appear that changes in anxiety levels within the specific thinking group were associated with Stroop task performance. Similarly, in the cognitive control (OSPAN) group, the associations between Stroop task performance and anxiety levels were not significant: for T2 anxiety, r = -0.17, p = 0.32, for T3 anxiety, r = -0.18, p = 0.31, and for the difference between T2 and T3 anxiety, r = 0.01, p = 0.95.

Hypothesis 3: Increased anxiety results in poor cognitive control. Finally, I examined whether increased anxiety in the overgeneralized group resulted in poorer Stroop task performance than the non-emotional control group. On the Stroop task, the overgeneralized and the non-emotional control groups did not differ in their performance on the Stroop task, t (76) = 0.78, p = 0.44, d = 0.2. For specific contrast 6, where the overegneralized group was compared to the non-emotional control group, the groups also did not differ in their performance, t (139) = -0.01, p = 0.10, d < 0.01.Therefore, the hypothesis that negative mood results in poor cognitive control was not supported.

Discussion

The aim of the current study was to investigate whether engaging cognitive control down regulates negative affect. Hypothesis 1 investigated whether cognitive control decreases negative affect, however, this hypothesis was not supported. One caveat to this lack of support for hypothesis 1 is that the effect of cognitive control on negative affect could not be compared to a manipulation that did decrease negative affect. Hypothesis 2 investigated whether the specific thinking strategy involves engaging cognitive control and engaging cognitive control is related to decreased anxiety levels. There was suggestive evidence, although far from conclusive, that the specific thinking task engaged cognitive control, but not that cognitive control engagement was related to decreased anxiety. Hypothesis 3 investigated whether negative affect decreases performance on cognitive control tasks, however, this hypothesis was not supported. In the remainder of this paper I will examine the results for each hypothesis in detail and discuss ideas for future research to further clarify the relationship between cognitive control and the down regulation of negative affect.

Hypothesis 1: Engaging cognitive control decreases negative affect

Hypothesis 1 of this study investigated whether engaging cognitive control decreased negative affect. The findings of this study did not support this hypothesis. When the anxiety level of the cognitive control group was compared before and after the cognitive control mental training task, the OSPAN (Turner & Engle, 1989), a significant decrease in anxiety was not found.

Previous research indicates there may a correlation between cognitive control and negative affect (Philippot et al., 2006). The current study tested whether a causal relationship exists between cognitive control and negative affect; however this relationship was not supported. One implication of this result may be that a third variable, such as the medial PFC (Johnstone et al., 2007), may act as a mediator between cognitive control and negative affect. The medial PFC becomes activated when explicit attempts are made to regulate negative affect (Johnstone et al, 2007). Thus, an indirect relationship between cognitive control and negative affect may exist. This suggests that although cognitive control may be engaged during emotion regulation (Schmeichel, 2007), cognitive control engagement by itself may not directly cause a decrease in negative mood.

One possible reason why cognitive control did not down regulate anxiety may be that cognitive control was not engaged by the OSPAN. However, cognitive control engagement was assessed in this study by including a secondary cognitive control task, the Stroop. If the OSPAN engaged cognitive control, then the OSPAN group's performance on the Stroop should be poorer than the non-emotional control group. As expected, the OSPAN group's performance on the Stroop task was poorer than the non-emotional control group. Hence, it appears that even though the OSPAN did engage cognitive control, engaging cognitive control did not down regulate anxiety.

Even though the OSPAN appeared to engage cognitive control, it is possible that the OSPAN task could have more strongly engaged cognitive control. One factor that can affect the difficulty of completing a working memory span task like the OSPAN is whether performance is participant or researcher paced. The OSPAN task involves both

verbally solving a mathematical equation and then memorizing a word. Recent evidence has found that cognitive control demands increase when participants have less time to solve the equations and can devote presumably less attention to memorizing the words (Barrouillet et al., 2007). In the current study, participants had an unlimited period of time to solve the mathematical equations and a review of their reaction times indicates that they took longer than on a commonly used computer paced version of the OSPAN (Unsworth, Heitz, Schrock, & Engle, 2005). Therefore, one issue for future research would be to examine whether an even greater demand of cognitive control resources would result in a decrease in negative affect.

Another issue for future research could be to examine whether engaging cognitive control would decrease anxiety that was caused by a different mood induction. There are at least two potential problems with the mood induction used in the current study. On the one hand, the mood induction used in the current study created anxiety in participants by suggesting that a stressful experience will occur in the future. Participants may have had some decrease in anxiety after the mental training tasks but then increased in anxiety again once they thought about having to give a speech in the near future. Of course, previous research using this mood manipulation has found that cognitive strategies can decrease negative affect (Philippot et al., 2006; although not replicated in the current study). However, a second possible problem with the public speaking manipulation is that it involved deception. In debriefing participants, it appears that some participants from the beginning were skeptical. In addition, there was evidence that for many participants skepticism increased during the study. Hence, future research could examine whether engaging cognitive control results in decreased negative affect without using deception. It

may also be that although engaging cognitive control may not reduce anxiety, it might reduce other types of negative affect, such as sadness or depression (Siegle, 2007).

Another important issue for future research examining whether cognitive control does not decrease negative affect would be to compare the engagement of cognitive control with a manipulation that does decrease negative affect. For example, a number of studies have found that cognitive reappraisal can decrease negative affect (Philippot et al., 2006; Gross & John, 2003; Gross, 1998). Future research could examine whether the engagement of cognitive control does not decrease negative affect when compared with cognitive reappraisal. This would provide even stronger support to the current evidence that engaging cognitive control did not decrease anxiety.

Hypothesis 2: The specific thinking strategy involves engaging cognitive control and engaging cognitive control is related to decreased anxiety levels.

Hypothesis 2 examined whether the specific thinking strategy involved engaging cognitive control. Some support for this hypothesis was found as the specific thinking group was similar in performance to the cognitive control (OSPAN) group. At the same time, the specific thinking group also tended to perform more poorly on the Stroop than the non-emotional control group, although this was not statistically significant. This evidence of potentially poor cognitive control after emotion regulation is consistent with research by Schmeichel (2007). However, the hypothesis may have had greater support in the current results if there were more participants in the specific thinking group (given the effect size of $d = 0.34$, the power to reject the null is 0.21).

There was also no correlation between anxiety and performance on the Stroop task for the specific thinking group. This finding further suggests that the specific

thinking manipulation, though potentially engaging cognitive control, does not decrease anxiety. Of course, this finding is limited by the lack of a significant decrease in anxiety after the specific thinking manipulation.

Hence, in contrast to Philippot et al. (2006), in the current study specific thinking did not decrease anxiety. This suggests that there may have been problems with our specific thinking manipulation. For example, participants may not have been fully engaged by the specific thinking manipulation. Therefore, participants in the specific thinking group may not have differed cognitively from the overgeneralized thinking group. Although I attempted to replicate the method used in Philippot et al.'s (2006) study, I may have missed some important but unspecified details that made the current replication of Philippot et al. (2006)'s work unsuccessful (see Appendix E). The procedure for the manipulation involved asking participants 10 questions in 10 minutes to guide participants towards specific thinking. The ability of the manipulation to guide participants to engage in specific thinking may vary depending upon the individual administering the manipulation. Unfortunately, there is not currently an easy way to control the direction and specificity of the participants' thoughts. For this study, I could only ask the participants to verbalize their thought processes truthfully and it did appear that participants were engaging in the specific thinking mental task.

One possible difference between the study by Philippot et al. (2006) and the current study may be that the current instructions used differed from the original study's script. The instructions used in the current study were received from Philippot et al. However, these scripts were translations of the original French scripts and they may not

have been sufficiently directive to guide participants to engage in specific vs. generalized thinking.

In reviewing any other possible differences between Philippot et al. (2006) and the current study, one difference is that the participants in Philippot et al.'s (2006) research were asked before the mental training tasks if their feelings were similar to previous public speaking situations. In that study, participants did not engage in the mental training tasks until they rated their feelings as very similar to previous public speaking situations. The current study did not ask this question before the mental training tasks but at the end of the study. However, when participants in the current study were asked follow up questions after the Stroop task, they did report experiencing similar feelings to previous public speaking situations. Further, consistent with Philippot et al., the mood induction in the current study did produce a significant increase in anxiety.

In addition, there were other similarities between the current study and the study from Philippot et al. (2006). For example, the current study used a similar mood induction task where participants were told they would give a speech on an unfamiliar topic. Participants in this study also had similar levels of anxiety to participants in Philippot et al. (2006)'s work, however, the mean anxiety of the current study was slightly lower (49.97 vs. 48.46, respectively). Further, participants in both studies participated in mental training tasks 10 minutes in length. Based on the similarities in the procedures of the current study and Philippot et al.'s study, one would predict that the mental training tasks would produce similar outcomes of decreasing negative affect. However, the subtle differences in methodologies may account for the different results between the Philippot et al. (2006) study and the current study. Future research

examining the specific thinking manipulation could include a different mood induction that does involve an impending stressor and also does not involve deception.

Hypothesis 3: Increased anxiety results in poor cognitive control.

Hypothesis 3 examined if increased anxiety resulted in poor cognitive control. I compared the overgeneralized and non-emotional control groups to examine whether their Stroop task performance differed due to anxiety levels. No significant difference was found between the overgeneralized and non-emotional control groups in Stroop task performance. Hence, the current study failed to support the hypothesis that anxiety decreases performance on cognitive control tasks.

Combined with previous research, the current results suggest that current negative mood may not be associated with poor cognitive control but, instead, that only prolonged negative mood may be associated with poor cognitive control. For instance, consistent with the current results, Rowe et al. (2007) failed to find a relationship between induced negative mood and cognitive performance on a Flanker task which has been found to load on the same cognitive factor as the Stroop task (Friedman & Miyake, 2004). However, research on more chronic distress, such as depressive symptoms or current life stress, has been shown to be positively related to cognitive control tasks like the OSPAN (Klein & Boals, 2001a; Klein & Boals, 2001b). Poorer performance with more chronic distress has been associated with more intrusive and ruminative thoughts (Dalgleish & Yiend 2006; Wenzlaff & Bates, 1998). Therefore, one possible implication of the current study is that current negative affect does not hurt cognitive control, but that more chronic distress, possibly involving intrusive thoughts, can decrease cognitive control. This suggests that

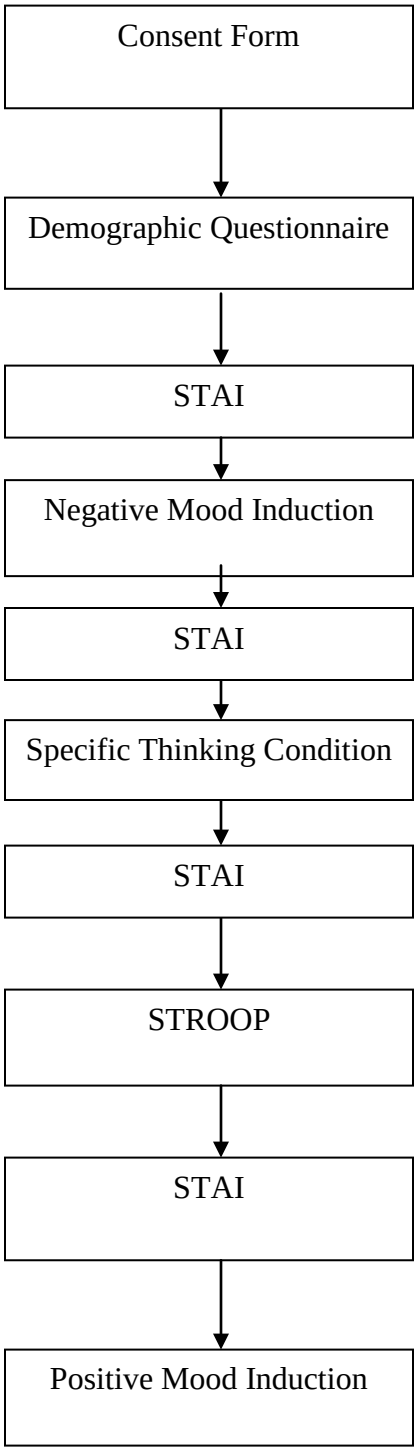
to understand how negative affect influences cognitive control that future research should focus specifically on people who have experienced more chronic distress.

Tentative Future Research Plans

As mentioned, one issue for future research is to examine whether and when the specific thinking decreased negative affect. However, given that I am not very confident about why I did not find that specific thinking decreased negative affect in the current study, in the immediate future, I am not planning on further examining the specific thinking emotion regulation strategy. Instead, in the future, I am planning on following up the finding that the cognitive control task did not directly down regulate negative affect. In currently planned follow-up study, I am planning on using a mood induction task that is not an impending stressor and does not involve deception to increase negative affect. Participants will then participate in an OSPAN task that is fully computerized and not participant paced. In addition, another task shown to decrease negative affect, the cognitive reappraisal task (Gross & John, 2003; Gross, 1998), will be used as a comparison for the cognitive control group. In this future study I will examine whether either cognitive reappraisal or cognitive control decreases negative affect. When combined with the results of the current study, this might provide strong evidence on whether engaging cognitive control does or does not decrease negative affect. Ultimately, it is hoped that this research will further help explain the mechanisms for how people regulate their negative emotions.

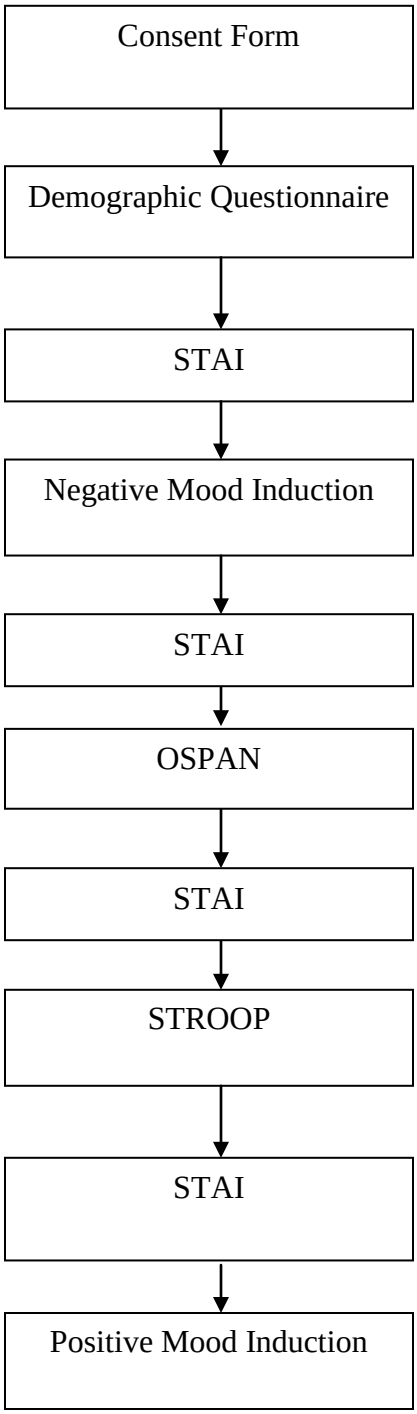
Appendix A

Summary of Specific Thinking Group Procedure



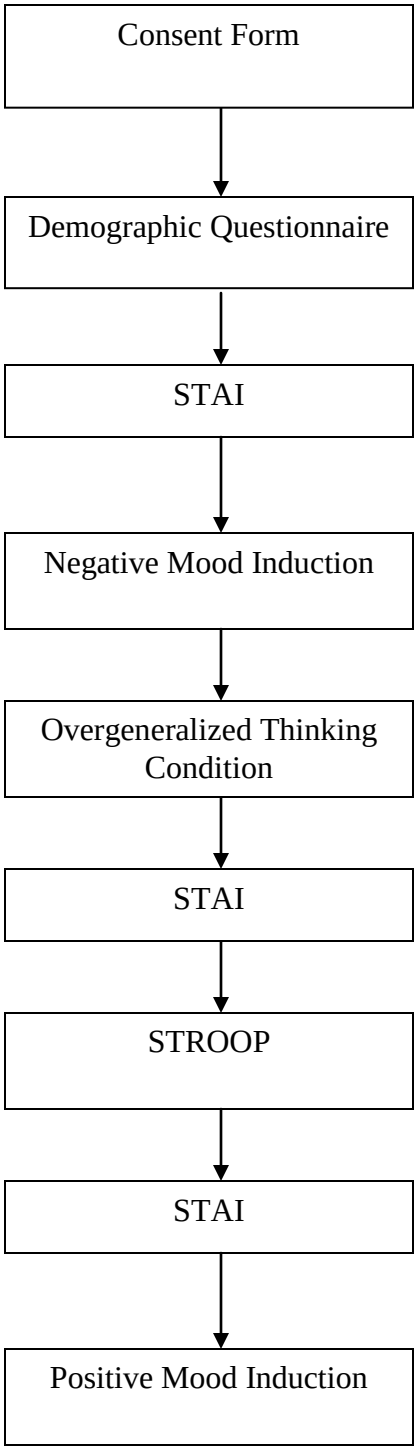
Appendix B

Summary of Cognitive Control Group Procedure



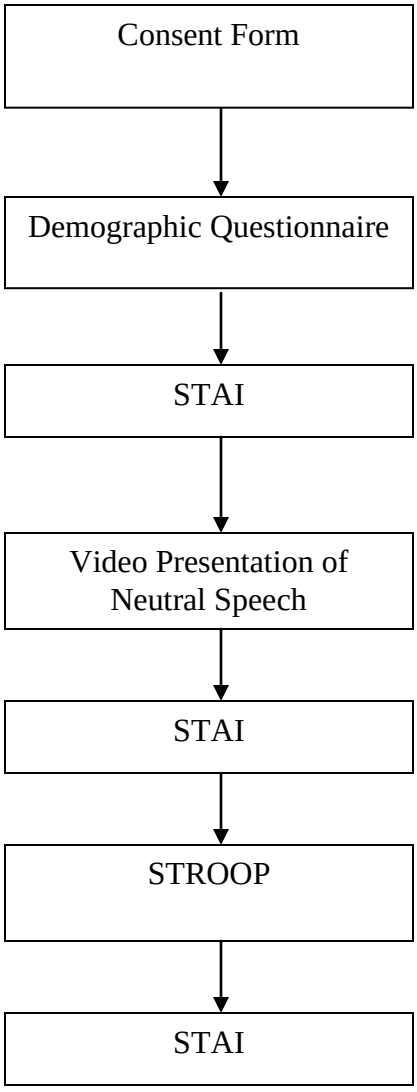
Appendix C

Summary of Overgeneralized Thinking Group Procedure



Appendix D

Summary of Non-emotional Control Group Procedure



Appendix E

Instructions for the specific thinking emotion regulation condition

Let me tell you a bit about the study. Public speaking is an important skill to have as communication is necessary for your professional career and your social life. The purpose of this study is to assess the speaking ability of different populations. For this study, you will give a 10 minute speech in front of a video camera on the economic threat of vegetation eating bacteria in Australia. Three judges will watch the tape and then will rate your speaking. Before you give the speech you will relax for 5 minutes and then have 10 minutes to do some mental training. Since speaking in front a camera is stressful for most people, this mental training has been added to the procedure to help people cope with stress.

(If participant says they are not familiar with the topic; appear somewhat surprised): Do the best that you can by using what you know about economic threats.

After 5 minutes to relaxation

Now I want you to focus on any emotions, spontaneous images and bodily sensations you are feeling as you wait to speak in front of the camera. I'll ask you questions and you respond as if you are thinking out loud.

1. Concentrate on your fears in this situation
2. Try to detail each of these fears
3. Try to think of what else could go wrong in this situation
4. Concentrate on the bodily sensations related to these fears
5. Analyze as precisely as possible the different shades of emotion that you can feel in this situation.

6. What emotion predominates and why?
7. Concentrate on the behaviours and reactions that would be triggered by your fears
8. Imagine in detail a catastrophic scenario at the end of your speech
9. Try to imagine another catastrophic scenario

Appendix F

Instructions for the cognitive control emotion regulation condition

Let me tell you a bit about the study. Public speaking is an important skill to have as communication is necessary for your professional career and your social life. The purpose of this study is to assess the speaking ability of different populations. For this study, you will give a 10 minute speech in front of a video camera on the economic threat of vegetation eating bacteria in Australia. Three judges will watch the tape and then will rate your speaking. Before you give the speech you will relax and have 10 minutes to do some mental training. Since speaking in front a camera is stressful for most people, this mental training has been added to the procedure to help people cope with stress.

Now I want you to focus on *this computer screen. You will see a simple mathematical equation followed by a word. You will determine if the equation is correct and then click on 'yes', or if the equation is incorrect, click 'no'. After you answer, a word will come up. You will need to remember the word after each equation. After several equations you will be asked to recall all the words and list them on this paper. You will then be given more equation-word pairs and then be asked to recall all the words since the last recall list. The number of equation-word pairs you will see before you are asked to recall the words will vary. Let's do an example (an example equation is shown). Do you have any questions?*

Appendix G

Instructions for the overgeneralized thinking emotion regulation condition

Let me tell you a bit about the study. Public speaking is an important skill to have as communication is necessary for your professional career and your social life. The purpose of this study is to assess the speaking ability of different populations. For this study, you will give a 10 minute speech in front of a video camera on the economic threat of vegetation eating bacteria in Australia. Three judges will watch the tape and then will rate your speaking. Before you give the speech you will relax and have 10 minutes to do some mental training. Since speaking in front a camera is stressful for most people, this mental training has been added to the procedure to help people cope with stress.

Now I want you to focus on any emotions, spontaneous images and bodily sensations you are feeling as you wait to speak in front of the camera. I'll ask you questions and you respond as if you are thinking out loud. Think about the general atmosphere that this situation spontaneously evokes in you.

1. Think about an image in relation to the situation that spontaneously comes to your mind.
2. Think about what this situation evokes for you, in a general way.
3. Think about the state you are in now.
4. Think about a color that you associate with this state.
5. Think about the body sensations that you associate with this state.
6. Think about the spontaneous reaction that you have in this situation.
7. Is this situation evoking another type of similar situation that you have already experienced?

Appendix H

Instructions for non-emotional control condition

Let me tell you a bit about the study. Public speaking is an important skill to have as communication is necessary for your professional career and your social life. The purpose of this study is to assess the speaking ability of different populations.

Now we have a video for you to watch of someone speaking. You will watch this video for the next 10 minute. After you are finished watching this video I will ask you, as a casual observer, what impressed you about the speech. Do you have any questions?

Okay, so relax and watch this video.

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