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Autobiographical memory specificity, negative mood state, and executive control: implications for clinical depression

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Autobiographical Memory Specificity, Negative Mood State, and Executive Control: Implications for Clinical Depression

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ABSTRACT

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Reduced autobiographical memory specificity and executive control have been associated with clinical depression; however, evidence is inconclusive as to whether these impairments represent trait-like qualities of individuals with clinical depression or are associated with changes in mood state. The present study employed a mood induction procedure and a digit-recall task derived to interfere with working memory to test the role of current mood and executive functioning in the autobiographical memory of non-depressed college students. Non-depressed subjects recalled significantly fewer specific memories on an autobiographical memory test following an induced, negative mood state and also with a concurrent digit-recall task. Thus, autobiographical memory specificity is related to current mood state and involves central executive processes which may be appropriate intervention targets.

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Autobiographical Memory Specificity, Negative Mood State, and Executive Control: Implications for Clinical Depression

Clinical depression is a major public health issue in the United States. Estimates of the risk for developing major depression within one's lifetime vary from 5% to 12% for men and 10% to 25% for women (DSM-IV-TR, 2000). The prevalence of this disorder is important considering the individual as well as societal costs. As Lau, Segal, and Williams (2004) have stated: "Alarmingly, this burden [depression] is projected to increase both absolutely and relatively such that by the year 2020 depression will impose the second greatest burden of ill health, very close behind the top cause, ischemic heart disease" (p. 1002). Clarification of specific factors that place individuals at risk for depression and/or relapse should result in more precise treatments and outcome measures that would lessen the personal and economic costs of the disorder.

Autobiographical memory specificity (AMS) and central executive control are two memory processes that have been linked to clinical depression (Dalgleish et al., 2007, Williams & Broadbent, 1986). In order to provide a rationale for how these memory factors may be used to clearly differentiate specific memory characteristics germane to clinical depression and those that correspond to everyday, negative mood states, reviews of basic memory terms and their relationships to both clinical depression and negative mood states in healthy individuals will follow.

Information-Processing Model of Memory

Cognitive psychologists typically divide memory into different types. For example, Atkinson and Shiffrin (1968) divided memory into the sensory registers, short-term, and long-term memory. Long-term memory can also be divided into non-

declarative and declarative memory. Non-declarative memory includes nonverbal or procedural information. For example, the memories needed for physically riding a bicycle or playing a musical instrument would be considered part of non-declarative memory whereas declarative memory contains verbal information. Declarative memory can be classified as either semantic memory, which is made up of facts and general knowledge, or episodic memory, which is made up of personal experiences in one's life (Tulving, 1993).

Baddeley (1986) replaced the concept of short-term memory with "working" memory. Working memory is the structure that allows us to gain access to and apply information in long-term memory to situations and problems that we encounter. While similar to short-term memory, an important difference between short-term memory and working memory is that working memory manipulates or elaborates on the information that is stored in long-term memory.

Autobiographical Memory and Depression

Autobiographical memory is a part of episodic memory that contains an individual's personal history of life events. Williams and Broadbent (1986) found that depressed and parasuicidal individuals performed poorly on a task now called the autobiographical memory task (AMT) in which subjects were asked to retrieve specific memories (single occasions or events that did not last longer than one day) in response to positive or negative cue words. Williams (2005) describes the AMT as a "…widely used method of assessing personal event memory in people with emotional disturbance" (p. 1). In the original application of the AMT to suicide attempters, Williams and Broadbent presented 10 emotional cue words to participants and gave them one minute to retrieve a

specific memory in response to each cue word. The words were originally presented in a fixed order from the following: *happy, sorry, safe, angry, interested, clumsy, successful, hurt, surprised* and *lonely*. The participants were asked to retrieve a specific memory defined as an event that lasted less than one day and occurred at a particular time and place. Williams suggests prompting participants to retrieve a specific memory on at least two practice words before proceeding with AMT administration. Any subsequent prompting is left to the discretion of the experimenter. Memories are coded as either specific or non-specific. Specific autobiographical memories are those that satisfy the instruction criteria of an event that occurred at a specific place and time and that lasted less than one day (Williams, et al., 2007). Williams suggests separating non-specific memories into categories of semantic associates, general categoric memories, general extended memories, and omissions.

The AMT has been occasionally modified by administrators by adding more cue words, decreasing the time allowed to respond to 30 seconds, and adding neutral cue words (Williams, 2005). Recent variations have included a computerized version of the original AMT whereby participants type responses (in contrast to an interview format), as well as a sentence-completion format (Raes, Hermans, Williams, & Eelen, 2007; Rekart, Mineka, & Zinbarg, 2006).

In their original study, Williams and Broadbent (1986) concluded that poor performance on the AMT by depressed and suicidal subjects was accounted for by a tendency to incorrectly produce overgeneral memories (OGM) instead of specific ones. For example, a specific autobiographical memory to the cue word *happy* could be as follows: *One Christmas morning I received a new watch from my brother.* An example of

an overgeneral memory, and one more likely to be produced by depressed and parasuicidal individuals, might be: *Whenever we would celebrate Christmas mornings.* Researchers have consistently found that clinically depressed individuals as well as individuals with other emotional disorders such as posttraumatic stress disorder (PTSD), eating disorders, borderline personality disorder, and acute stress disorder show an overgeneral style of autobiographical memory (Kuyken, Howell & Dalgleish, 2006; Mackinger, Leibetseder, Pachinger & Fartacek, 2000; Moffitt, Singer, Nelligan, Carlson & Vyse, 1994; Raes et al., 2006; Williams & Dritschel, 1988). The relationship between overgeneral memory and clinical depression has been referred to as "…one of the most reliable features of memory in depression" (Brewin, Reynolds, & Tata, 1999, p. 512).

The relationship between depression and overgeneral memory is thought to have important implications for mental health. Williams (1996) proposed that overgeneral memories do not contain specific details relevant to an individual's personal experiences, and can lead to difficulty in emotional and cognitive areas. Specifically, Williams proposed that overgeneral memory causes episodes of emotional disturbance to be more persistent. It also impairs interpersonal problem-solving ability because past experiences cannot be used as references for effective coping strategies, and it impairs a person's ability to imagine specific scenarios in the future. Thus, when a person is depressed, he or she is likely to either solve interpersonal problems poorly or avoid them completely. Without a specific record of our past successes and failures, it would be difficult to select the best problem-solving strategies when we encounter similar problems in the future that we have faced in the past (Williams, Barnhofer, Crane, & Duggan, 2006). These problems may lead to further depression resulting from factors such as increased stress

and hopelessness. In fact, reduced AMS has been found to be predictive of slower recovery from clinical depression in longitudinal studies (Brewin et al., 1999; Brittlebank, Scott, Williams, & Ferrier, 1993).

Brewin et al. (1999) found that overgeneral memory was associated with increased reports of spontaneous, intrusive memories of stressful events which were correlated with level of depression at a 6-month follow-up. Brittlebank et al. (1993) assessed subjects' number of overgeneral memories on the AMT as well as the level of depressive symptomology with the Hamilton Depression Rating Scale for Depression (HRSD) at baseline, 3-month, and 7-month follow-ups. The number of overgeneral responses was positively correlated with HRSD scores accounting for 33% of the variance at 7-month follow-up. Moreover, level of overgeneral memory did not change from baseline to the 7-month follow-up assessment raising the question of whether the relationship between overgeneral autobiographical memory and depression represents a trait of individuals with depression or a phenomenon of depressed mood state.

Overgeneral Memory as a Trait v. State Phenomenon in Depression

The numerous findings of a relationship between depression and overgeneral memory have led some authors to conclude that it is a stable marker of clinical depression independent of mood state (Van Vreeswijk & de Wild, 2004). In this view, overgeneral memory is a *trait-like* marker differentiating candidates for a clinical diagnosis of a depressive disorder rather than a factor related to a current mood state. Support for this model comes from Mackinger, Leibetseder, Pachinger, and Fartacek (2000) as well as Spinhoven et al. (2006) who found that overgeneral memory persists in formerly depressed individuals even when current mood is undisturbed.

Recent findings, however, suggest that the relationship between depression and overgeneral memory is not related to a trait-like marker of clinical depression. Rather it is due to experiencing a time-limited, negative shift in overall mood (Au Yeung, Dalgleish, Golden, & Schartau, 2006; McBride, Segal, Kennedy, & Gemar, 2007; Williams, Teasdale, Segal, & Soulsby, 2000). Au Yeung et al. (2006) examined whether healthy participants with no history of depression would exhibit overgeneral memory following a slight change in their current mood state. Participants underwent either a negative, neutral, or positive mood induction procedure that consisted of listening to pieces of music or viewing video clips. The healthy participants completed the AMT both pre-mood induction and post-mood induction. Results indicated that the negative mood induction and lower self-reported happiness scores were significantly related to overgeneral memory on the AMT. Current depressive symptomology as reported on the Beck Depression Inventory (BDI) was not. Furthermore, overgeneral memory can be reduced by treatment with cognitive behavior therapy, pharmacotherapy, and mindfulness-based therapy for major depression (McBride et al., 2007; Williams et al., 2000).

These findings suggest that overgeneral memory is not solely a trait of vulnerability to major depression. Au Yeung, et al. (2006) suggested that this may indicate that overgeneral memory is a multi-faceted phenomenon with some factors being related to current emotional state and some factors being related to stable features of depression. An alternative is that overgeneral memory is solely related to current emotional state. Regardless the results raise doubt about whether overgeneral memory alone can be used to identify those who are vulnerable to clinical depression.

As stated previously, discovery of a stable facet of clinical depression involved in overgeneral memory would have important clinical implications. If clinicians could target those aspects of clinical depression that make an individual vulnerable to depressive episodes and relapse, then greater precision in treatment might be possible. However, recent research reviewed above raises doubt about whether overgeneral memory is solely a trait-marker of depressed individuals. It is hoped that other related cognitive mechanisms may differentiate between healthy individuals experiencing a change in mood state and individuals with current or historical depressive symptomology. One cognitive variable that has recently been associated with overgeneral memory is executive control (Dalgleish et al., 2007; Williams et al., 2007).

Executive Control

Baddeley (1986) proposed a model of working memory that revised the concept of short-term memory introduced in the information-processing model of Atkinson and Shiffrin (1968). Baddeley originally proposed that working memory is made up of at least three structures responsible for different processes in working memory. These structures are called the central executive, which is thought to be responsible for the allocation of attentional resources to cognitive tasks such as problem solving, the visuo-spatial sketchpad or scratchpad, which is responsible for visual and spatial information, and the phonological or articulatory loop, which is responsible for processing auditory or language-based information (Rosen & Engle, 1997). Baddeley proposed that the visuo-spatial sketchpad and phonological loop can function rather independently and automatically to work with information stored in long-term memory, but require the effortful control of the central executive to select information from memory that is most

relevant to the task at hand. If attentional resources are being used by other cognitive tasks, then additional demands are placed on the central executive and working memory may operate in ways that are less productive than under normal conditions.

Depression, Executive Control, and Autobiographical Memory

The results of studies implicating the central executive in depression and overgeneral memory have not been completely consistent. One theory of the relationship between overgeneral memory, depression, and executive control has employed the concept of a truncated, hierarchy-based memory search (Conway & Pleydell-Pearce, 2000; Oaksford, Grainger, Morris, & Williams, 1996: Williams et al., 2007).

This model proposes that generating a specific autobiographical memory requires a top-down process, whereby in response to a cue word an individual initiates a search through a series of categories in long-term memory that increase in complexity and specificity the further one progresses down the hierarchy (Williams, Chan, Crane, & Barnhofer, 2006). The stages of the hierarchy correspond to semantic associations, generic categorical memories, and specific memories. Williams et al. (2006) presented the following example. A participant is presented with the cue word "angry." The next step is generation of a general semantic associate for the word—"My dad." Next, a generic or categorical memory is generated for the cue-word—"Every time I failed an exam my dad used to criticize me." Finally, a specific memory, a single event that lasted no longer than one day, is generated—"The time he threw a fit when I told him my marks" (p. 353). The authors suggest the tendency for depressed individuals to produce overgeneral memories in response to emotional cue-words is the result of a truncated

search. In other words, these individuals pre-maturely stop their memory search at a higher, less specific stage of the hierarchy.

Consistent with this proposal, Williams et al. (2006) observed that subjects produced significantly more specific memories on the AMT when the cue-words were rated as high in imageability, thereby making it possible to have more sensory/perceptual cues for the search. When participants were given cue-words with less imageability (making the search more effortful), they retrieved more general memories. Explanations for this truncated search have included the role of executive control.

Executive control has been broadly defined as "…the set of cognitive processes that are responsible for the planning, initiation, sequencing, and monitoring of complex goal-directed behavior in the face of distracting information" (Dalgleish et al., 2007, p. 25). Dalgleish et al. proposed that overgeneral memory may result from poor retrieval strategies, difficulty in maintaining and/or applying task instructions, and/or difficulty inhibiting inappropriate responses during the task, i.e. executive control issues. Williams et al. (2006) tested the involvement of executive control processes within the hierarchical search model. The authors predicted that if less executive control capacity is required for a general memory (i.e. retrieval at a higher level of the search hierarchy), then the randomness of a concurrent random number generation task would be less disrupted if participants were explicitly asked for a general memory as compared to specific memories. Although the results showed that randomness was significantly greater at baseline than while also completing an autobiographical memory task, there was no significant difference between asking for general memories v. specific memories (study 2). This finding was inconsistent with the results of a previous study examining the effect

of executive control on autobiographical memory (Goddard, Dritschel, & Burton, 1998). In this study an autobiographical memory task was performed concurrently with a four-choice reaction time task with varying levels of difficulty. The authors found that significantly more specific autobiographical memories were recalled in the easy conditions and more generic autobiographical memories were recalled in the difficult conditions. Williams et al. (2006) reviewed the findings of a 2004 study by Dalgleish that suggested overgeneral memory was associated with the number of errors on tasks suggesting goal-neglect, or the loss of focus on the task. The authors provided the following example of this, "…a person giving an illegitimate response on verbal fluency task (*generate as many* [different] *words as you can in a minute beginning with "s"*) by saying not only swim (legitimate) but then also "swimmer, swimming, swims" (p.378). This represents a problem in inhibiting incorrect responses, and is thus associated with executive control.

There have been mixed results from studies examining executive control and depression. For example, one investigation into depression-specific memory disturbances found that depressed participants demonstrated deficits in *all* aspects of working memory (Christopher & MacDonald, 2005). However, Channon et al. (1993) tested several aspects of working memory in depressed and healthy control subjects and found that clinically depressed participants and control participants *did not differ* on several measures involving the phonological loop or visual-spatial sketchpad. With regard to central executive processing, depressed participants differed significantly on a backward digit span task. Other tasks used for measuring central executive functioning showed no difference between depressed subjects and controls.

Rose and Ebmeier (2006) also found little effect of depression on the central executive. They compared the effects of depression on central executive working functioning using a parametric *n*-back task. This task involves presenting a participant with a series of four boxes on a screen for a brief period of time. The boxes are numbered, and one of them contains a colored dot. Participants are to respond with the number of the box that contained the dot. Task difficulty is manipulated by requiring the participant to report the dot's location on a specified trial that occurred before the current trial. For example, a 3-back task in this paradigm would require the participant to report the location of the dot three trials before. Rose and Ebmeier hypothesized that reaction time would increase and accuracy would decrease more with advancing task difficulty in depressed participants than in controls because the required attentional resources for this task would be expected to increase with task difficulty. Results indicated that cognitive load did not show the predicted effect on accuracy and reaction time.

Dalgleish et al. (2007) proposed that mixed results concerning executive control and depression may be due to insufficient manipulation of the cognitive load of the participants in previous experiments. A recently conducted series of studies on the role of executive control in autobiographical memory found that manipulating cognitive load on the AMT by having participants attempt to remember strings of digits until after they had responded to AMT items resulted in diminished autobiographical memory specificity (Dalgleish et al., 2007, study 7). They concluded that manipulation of executive control processes in ways that should impair retrieval of autobiographical memories should also influence AMS. These results are consistent with the findings presented above in which a backward digit-span task affected the memory performance of depressed participants

more than the performance of control participants. Dalgleish et al. (2007) also found that the effect was more pronounced with in subjects with deeper levels of clinical depression over the previous week. This investigation, however, did not include current mood state as a variable.

Present Study

The present study was designed to address two areas of uncertainty concerning overgeneral memory: 1) Is overgeneral memory a characteristic of current mood state or a characteristic of clinical depression? 2) Is executive control in working memory implicated as a primary source of the effect? As discussed above, while some studies have suggested that overgeneral memory is a trait-like marker for depression recent developments in the literature have pointed to the possibility that it is modifiable and related to a change in mood state of non clinically-depressed individuals (Au Yeung et al., 2006; McBride et al, 2007). Identification of a facet of overgeneral memory that differentiates between individuals with a trait-like marker of clinical depression and those without would have valuable clinical implications in terms of precise targets for treatment. While data from Dalgleish et al. (2007) suggests that one facet of overgeneral memory is executive control, their study tested volunteers from a non-clinical population with varying levels of depressive symptomology, but they did not include a measure of current mood state.

The present study employed a mood induction procedure and a task designed to interfere with working memory to test the role of current mood and executive function in overgeneral memory. The central hypothesis of this study, in line with the theoretical model reviewed by Williams et al. (2007), was that impaired executive control occurs

during a negative shift in mood. This factor that is responsible for the overgeneral memory observed following a negative mood shift (e.g., Au Yeung et al. 2006). Therefore, it was expected that a group of non-depressed college students' performance on an AMT would be impaired because of reduced executive control whether they experienced a negative shift in mood state via a musical mood induction procedure, or greater demand placed on central executive processing via a concurrent digit-recall task.

Music plus instruction was used as a mood induction procedure in the present study. Westermann, Spies, Stahl, and Hesse (1996) conducted a meta-analysis of the effects of various mood induction procedures and found a mean weighted effect size of 0.503 for mood induction procedures incorporating music clips plus instruction to participants. Of the 250 studies analyzed in this meta-analysis, 67% stated a main purpose of investigating the impact of emotion on other cognitive or behavioral variables. The authors concluded that presentation of music clips along with instructions was superior to music alone which produced a mean weighted effect of 0.410. Furthermore, use of musical clips for induction of mood states was found to be approximately as effective as other established methods, including Velten procedures, social interaction, and feedback, but less effective than mood induction procedures utilizing film. A recent study, however, found no significant difference between mood induction procedures utilizing film clips and procedures utilizing music clips on autobiographical memory specificity and current mood state (Au Yeung et al., 2006). Furthermore, recent developments suggest that musical mood induction procedures may be especially suitable to studying relationships between cognition and depression (Mongrain & Trambakoulos,

2007). Therefore, the mood induction procedure selected for the current study was warranted.

Method

Subjects

The subjects were 81 (58 females and 23 males, mean age = 21.9 years) Marshall University students recruited from psychology classes. They received extra course credit for their participation. Students who were currently being treated for clinical depression by psychotherapy/counseling and/or medication or who had a significant hearing impairment were asked to refrain from signing up for the study. One participant requested to terminate his participation during the study and his data were excluded from the analysis.

Materials and measures

Demographic questionnaire. A brief demographics questionnaire was developed to gather basic information such as age, sex, and race (See Appendix A). In addition, an item asked participants whether they were currently being treated for a diagnosis of clinical depression by means of medication and/or therapy/counseling. The questionnaire also contained two items from the structured clinical interview (SCID) for the DSM-IV that have been used as a proxy measure for lifetime history of depression (Au Yeung et al., 2006). The two SCID questions used were A1 (Has there ever been a period of time when you were feeling depressed or down most of the day, nearly every day? What was that like? How long did it last? As long as two weeks?) and A2 (Have you ever lost interest or pleasure in things you usually enjoyed? Was it nearly every day? How long did it last? As long as two weeks?) from the major depressive episode sections.

Consistent with procedure described by Au Yeung et al. (2006), each questionnaire was scored either as present or absent for lifetime history of major depression based on endorsement of one or both questions.

Mood induction materials. Five-minute audio clips from two musical pieces used in previous studies (Au Yeung et al., 2006; Clark & Teasdale, 1985) were selected to induce negative and positive mood states in this study. The music for the negative, or sad, mood induction was taken from *Russia Under the Mongolian Yoke* from *Alexander Nevsky* by Prokofiev which has been shown to induce a transient, depressed mood state (Lethbridge & Allen, 2008). The music for the positive, or happy mood induction was the *Mazurka* from the ballet *Coppelia* by Delibes. This piece has been found to have no significant effect on autobiographical memory (Au Yeung et al., 2006). Therefore, the piece was intended as a control procedure in the present study.

Both music clips were presented to participants via headphones and an Olympus digital voice recorder for a duration of 5 minutes. Prior to listening to each of the music clips, the experimenter read the following instructions to all participants: *Please listen to the piece of music on these headphones. As you listen, try to pay attention to any feelings that come up and try to just let yourself get into the mood of the music*.

Manipulation check. Self-report ratings of current mood state were obtained both before and after mood inductions with 7 point Likert scales of 10 different emotions (See Appendix B). The rating scale ranged from 1 (I don't feel this way at all) to 7 (I feel extremely this way). The measure included ten adjectives and included the following: *Satisfied, Down, Depressed, Pleased, Glum, Happy, Troubled, Sad, Glad,* and *Cheerful*. The words were presented in fixed, random order to all participants.

Autobiographical memory test (AMT). The original interview format of the AMT was used for the present study in order to allow for simultaneous manipulation of executive control processes via a procedure similar to the one described by Dalgleish et al. (2007, study 7). Two versions of the AMT were developed for the present study. Each version consisted of 20 cue words selected from those used in Brittlebank et al. (1993) presented in fixed, random order (See Appendix C and D). The cue words on the two autobiographical memory tests (Form A and Form B) were matched for emotionality and frequency. Form A consisted of the following 20 cue words: *Blame, Calm, Hurt, Glorious, Sad, Helpless, Sunny, Fault, Eager, Proud, Hopeful, Grave, Guilty, Bored, Ugly, Pleased, Smile, Misery, Relieved,* and *Happy*. Form B consisted of the following 20 cue words: *Friendly, Ashamed, Upset, Rejected, Awful, Lively, Lucky, Worse, Grief, Cheer, Solemn, Faithful, Hopeless, Amazed, Carefree, Peaceful, Bad, Devoted, Weakness,* and *Joy*. Instructions to participants on both versions were as follows:

> *I am interested in your memory for events that have happened in your life. I am going to read to you some words. For each word I want you to think of an event that happened to you which the word reminds you of. The event could have happened recently (yesterday, last week) or a long time ago. It might be an important event or trivial event. Just one more thing: the memory you recall should be a specific event—an event that lasted less than a day, and occurred at a particular time and place. So if I said the word "good"—it would not be OK to say, "I always enjoy a good party," because that does not mention a specific event. But it would be OK to say "I had a good time at Jane's party" (because*

that is a specific event). It is important to try to retrieve a different memory or event for each cue word. Let us try some words for practice. (Williams, 2005)

Three neutral, practice words were included for each version of the AMT. The practice words for Form A consisted of *Car, Tree, and Chair,* and the practice words for Form B consisted of *Rain, Newspaper, and Milk.* All participants were required to provide a specific memory for at least 2 of 3 practice trials before beginning the test trials. Subjects who were given digit recall instructions were additionally required to correctly recall three digits on 2 of 3 practice trials before beginning the test trials. Subjects were prompted for specific responses only during the practice trials preceding each administration of the AMT.

Design

The experiment employed a 2x2x2 split-plot factorial design with one within-subjects factor, mood (Positive or Negative), and two between-subjects factors, mood order (Positive-Negative or Negative-Positive) and task type (Digit Recall Task or No Digit Recall Task). Participants were assigned to conditions by random assignment. To control for order effects, the order of presentation of both the autobiographical memory tests (Versions A and B) as well as the mood induction materials (negative and positive) were counterbalanced resulting in 8 conditions.

Procedure

All participants completed informed consent documents followed by the demographics questionnaire. The participants next rated their current, or baseline, mood level with the self-report mood rating form. Participants in the no digit recall condition then listened to their first mood induction for 5 minutes. They next completed the self-

report mood rating form followed by Version A or B of the AMT. These participants then listened to the opposite mood induction for 5 minutes. Finally, they completed the self-report mood rating form for a third time followed the other list version (A or B) of the AMT.

The digit recall condition was identical to the first condition with the exception that before each cue word of the AMT was presented subjects heard a three digit, random number they were to hold in memory and recall in proper order immediately following their memory response (See Appendix E and F for sequences). All administrations of the autobiographical memory tests were recorded with an Olympus digital voice recorder and responses were transcribed for scoring.

Results

Mood Manipulation

In order to verify whether the experimental mood induction was successful composite mood scores were calculated for each participant for each time of administration: Baseline (following completion of the informed consent), Time 1 (following the first mood induction), and Time 2 (following the second mood induction). The composite scores were calculated by summing self-report ratings on all adjectives on the mood questionnaire employing reverse scoring of the negative-valenced items. Thus, higher scores reflect a greater degree of positive mood. Reliability of the measure was .925, .948, and .948 (Cronbach's alpha) at Baseline, Time 1, and Time 2 respectively. A within-subjects analysis of variance with an alpha level of .05 indicated a statistically significant main effect for time, $F(2,77) = 8.15$, $p < .01$ as well as a statistically significant time by order interaction $F(2,77) = 48.72$, $p < .01$ for the positive and negative

mood inductions. As shown in Figure 1, and consistent with expectations, mean within-subjects self-reported mood increased (became more positive) following the positive mood induction and decreased (became more negative) following the negative mood induction procedure.

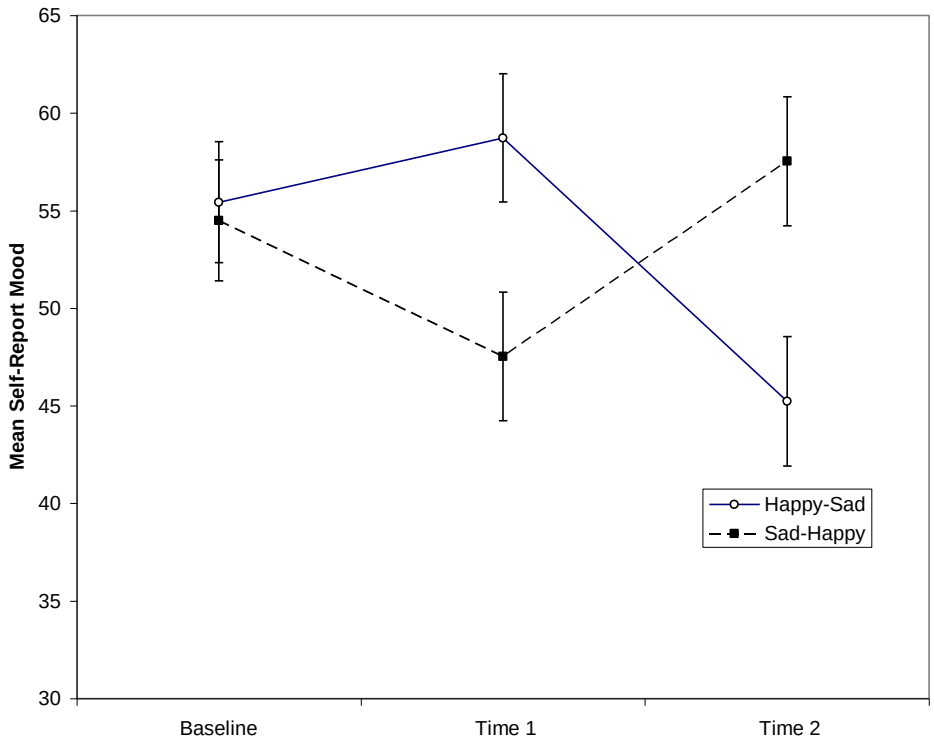

Figure 1. Mean self-report mood rating with at Baseline, Time 1, and Time 2 for each order of mood induction. Error tabs reflect 95% confidence intervals.

Autobiographical Memory Specificity

Number of specific memories recalled on each AMT was used as the dependent variable. Consistent with recommendations from Williams (2005), responses were scored as specific only if they satisfied the criteria listed in the instructions of including an event that lasted less than one day and happened at a particular time and place, and were given within the 30-sec. time limit. All other responses were scored as non-specific and

included semantic associations (words or phrases associated with the cue word, e.g., a response of "Chocolate" with no further elaboration of a specific event), extended general memories (an event lasting longer than a day, e.g., "my vacation to Myrtle Beach last week"), categorical general memories (repeated activities, e.g., "going on trips to the mountains with my dad"), and omissions (no-response given or a response given after the 30-sec. time-limit).

The results were analyzed in a 2x2x2 analysis of variance with mood condition (Positive or Negative) as a within-subjects factor, and condition order (Positive-Negative or Negative-Positive) and Task (Digit Recall Task or No Digit Recall Task) as between-subjects factors. The results indicated a significant main effect for mood, $F(1,76) = 4.10$, $p < .05$, $\eta_p^2 = .05$. As can be seen in Figure 2, subjects produced fewer specific memories on the AMT while in the negative mood than the positive mood. In addition, there was a significant main effect for Task, $F(1,76) = 4.72$, $p < .05$, $\eta_p^2 = .06$. As is also apparent in Figure 2, subjects in the digit recall condition recalled fewer specific memories than subjects in the non-digit recall condition. No other effects or interactions were significant, $F < 1$ in all cases.

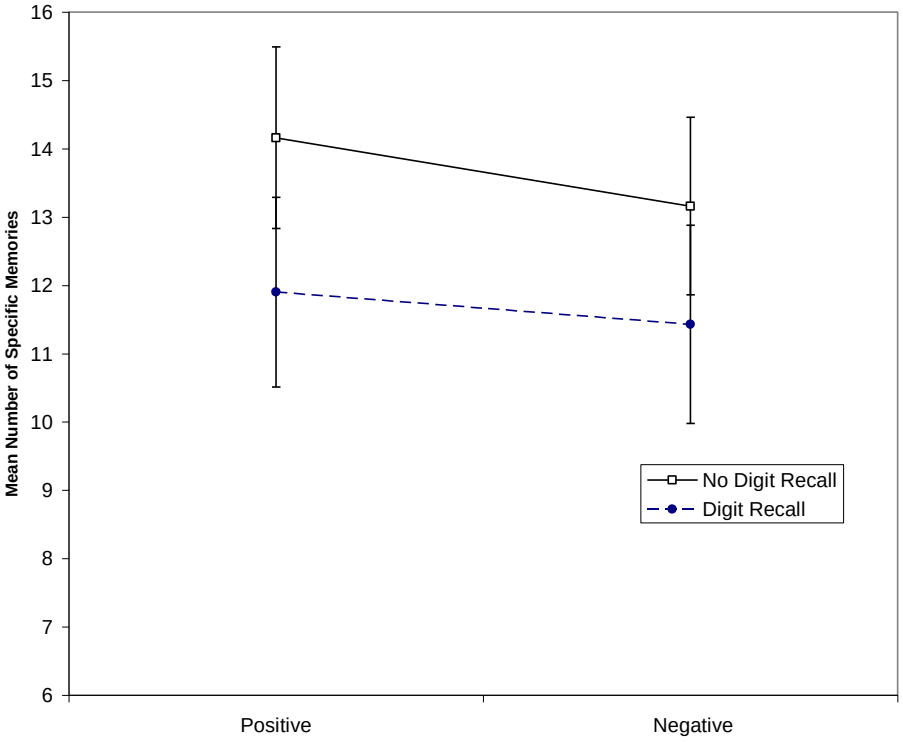

Figure 2. Mean number of specific memories recalled on the AMT following positive and negative mood induction for the AMT + Digit Recall (n = 40) and AMT alone (n =40). Error tabs reflect 95% confidence intervals.

Discussion

The purpose of the present study was to test the relationship between executive control, temporary mood, and overgeneral memory in non-depressed volunteers. As expected, non-depressed college students tended to recall significantly fewer specific memories on an autobiographical memory test following an induced, negative mood state. This finding provides support for the notion that overgeneral memory is not solely a trait-like characteristic of individuals suffering from clinical depression, but is clearly related to brief, state-like reductions in mood. Therefore, it cannot be used to differentiate between individuals with depressive traits and those without specific vulnerabilities to

clinical depression. The present data suggest that overgeneral memory occurs in clinical depression because of current mood.

Placing demand on executive control processes with a concurrent digit-recall task also led to significantly fewer specific memories being recalled by participants. The present findings support and extend the findings of Williams et al. (2007) by including a measure of current mood-state. In the present study, interference of executive control processes led to reduced specificity on the AMT even when current, self-reported mood state was relatively positive. The overall implication for clinical psychology is that therapeutic treatments targeting cognitive processes that affect executive control are likely to be appropriate interventions for overgeneral memory, and improving overgeneral memory may be an important step in preventing relapse to clinical depression.

Evidence is emerging in support of this idea. For example, McBride et al. (2007) assigned depressed patients to either cognitive behavior therapy (CBT) or pharmacotherapy, and measured overgeneral memory before and after treatment. Results indicated that both groups showed a decrease in categoric, overgeneral memories, but that the CBT group showed a greater decrease in the number of extended, overgeneral memories leading to the conclusion that "…an intervention that specifically targets the cognitive system exerts a greater change in one type of overgeneral memory than an intervention that does not specifically target the cognitive system" (p. 151). Williams et al. (2000) assessed overgeneral memory of formerly depressed subjects prior to and 12 months after receiving either an 8-week course of mindfulness-based cognitive therapy (MBCT) or treatment as usual (TAU). MBCT employs training adapted from the Stress

Reduction and Relaxation Program of the University of Massachusetts Medical Center combined with techniques from traditional cognitive therapy. The mindfulness component stresses learning to increase moment-to-moment awareness by practicing focusing attention on everyday tasks (i.e. breathing), and to notice when one's attention has been diverted to distressing thoughts. TAU was defined as remaining under the care of a physician for the duration of the study, and employing whatever services would normally be used in the event of a depressive episode. Results showed that subjects who received the MBCT tended to produce more specific memories at a 12-week follow-up than the TAU controls. Williams et al. (2000) proposed that this was because MBCT includes a large number of tasks that teach improved observation of specific aspects of the environment which would potentially reduce overgeneral encoding of memories. They also proposed that explicitly focusing on, and allowing mental events to occur without judging them or to trying to suppress or avoid them, as is done in MBCT, potentially reduced the tendency to truncate memory searches at an overgeneral level.

A potential limitation of the current study is that it included only one manipulation of executive control processes (digit recall) that contained the same number of digits in each trial. Similarly, the mood-induction materials used in this study included only one positive and one negative valence medium. Future studies varying the difficulty of executive processing tasks, such as those employed by Goddard et al. (1998), as well as differing strengths of mood-induction media, such as the incremental methods employed by Mongrain and Trambakoulos (2007), may make it possible for more sensitive examination of the relationship between executive control and mood-state.

A question raised by these findings concerns the mechanism by which executive functioning becomes reduced in depressed individuals if not by mood-state itself. One possible explanation is the contribution of rumination. Joorman and Gotlib (2008) define rumination as "recurrent and often unintentional and uncontrollable thoughts that involve negative, self-deprecating statements and pessimistic ideas about the self, the world, and the future" (p. 182). Rumination is considered to be a defining characteristic of certain psychological disorders including depression and PTSD, both of which have been associated with reduced autobiographical memory specificity (Williams et al., 2007). Rumination as discussed by Joorman and Gotlib (2008) is proposed as a mechanism for inhibition failure in working memory in which negative, emotional memories and sensory/perceptual associations become activated by emotional cue words. The activation of emotional memories creates difficulty in inhibiting irrelevant information from occupying working memory, leading to difficulty in retrieval. Joorman and Gotlib utilized a task in which participants memorized two word lists after being informed that only one of the lists would need to be remembered later. Participants were then presented with a word and asked to indicate whether it was from the to-be-remembered list. Both clinically depressed participants and non-depressed participants who were experimentally induced to feel sad were tested. They found that depressed participants showed greater intrusions of words from the not-to-be-remembered list when presented with negative words, and that this effect was correlated with self-reported rumination. In other words, depressed individuals were less able to remove irrelevant information (words from the to-be-ignored list) from working memory, thus interfering with their ability to inhibit potential incorrect responses. Depressed participants also showed greater difficulty

removing irrelevant information from working memory than non-depressed control subjects who underwent a negative mood induction suggesting that this effect was not dependent on current mood state. It is possible, however, that the mood induction may not have been of sufficient strength for the non-depressed subjects.

Watkins and Brown (2002) also examined the relationship between depression and executive functioning involving rumination. They manipulated participants' level of ruminative thinking to assess its impact on a random number generation task, a task believed to be a measure of executive functioning (Jahanshahi, Saleem, Ho, Dirnberger, & Fuller, 2006). Depressed and non-depressed controls completed the random number generation task following induced rumination by focusing on written items that were self and emotion focused (e.g., "Think about what your feelings might mean."), and induced distraction by focusing on items unrelated to feelings with an external focus (e.g., "Think about the shape of a large black umbrella.") (p.401). The results indicated that depressed participants performed more poorly on the random number generation task when compared to controls following the rumination induction, but not following the distraction induction. Singer and Dobson (2007) found similar effects when they trained formerly depressed patients in techniques of rumination, distraction, or acceptance of negative emotional states prior to receiving a negative mood induction. Control participants received no training prior to the mood induction. The subjects then engaged in the strategy in which they were trained following the negative mood induction. Results showed that subjects who used rumination maintained the intensity of the negative mood while subjects using distraction and/or acceptance techniques showed decreased negative mood.

Taken together, the evidence reviewed above suggests that rumination is associated with prolonged negative mood states, reduces executive control processes, and leads to difficulty inhibiting irrelevant information in working memory. Future studies employing methods similar to those of Joormin and Gotlib (2008) and Watkins and Brown (2002) may be beneficial in further clarifying mechanisms involved in reduced autobiographical memory, and may more clearly define a precise target of interventions to improve autobiographical memory specificity as data suggests that doing so may help prevent relapse to clinical depression.

The current study represents the first measurement of current mood state in relation to the observed effects of reduced executive control on autobiographical memory specificity. These findings suggest that executive control and current mood state are two factors involved in overgeneral memory. In addition, because these effects were produced in non-depressed volunteers, overgeneral memory does not appear to represent a trait-like characteristic of individuals prone to clinical depression. These findings are encouraging in light of recent evidence that improving executive functioning by reducing rumination should reduce overgeneral memory, and may aid in preventing depressive relapse.

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Appendix A: Demographics Questionnaire

Participant Number: _____ **Condition: _____**

Instructions: Please take a moment to answer a few questions about yourself. It is important that you answer as honestly as you can. It is also important that you **DO NOT PUT YOUR NAME** on any part of this form.

1.) What is your age? _____

2.) Sex: (circle one) Male Female

3.) Race:

4.) Are you currently being treated for a diagnosis of clinical depression by means of medication and/or therapy or counseling? _____

5.) Has there ever been a period of time when you were feeling depressed or down most of the day, nearly every day?

What was that like?

How long did it last?

As long as two weeks?

6.) Have you ever lost interest or pleasure in things you usually enjoyed?

Was it nearly every day?

How long did it last?

As long as two weeks?

Appendix B: Self-Report Mood Rating Scale

Participant Number: _____ Condition: _____ Time:_____

Instructions: Please consider the degree to which you are experiencing the following emotions ***at this very moment.*** Please circle the corresponding number for how you feel on each item.

1.) Satisfied

1 2 3 4 5 6 7

I don't feel this way at all **I feel extremely this way.**

2.) Down

1 2 3 4 5 6 7

I don't feel this way at all **I feel extremely this way.**

3.) Depressed

1 2 3 4 5 6 7

I don't feel this way at all **I feel extremely this way.**

4.) Pleased

1 2 3 4 5 6 7

I don't feel this way at all **I feel extremely this way.**

5.) Glum

1 2 3 4 5 6 7

I don't feel this way at all **I feel extremely this way.**

6.) Happy

1	2	3	4	5	6	7
I don't feel this way at all						**I feel extremely this way.**

7.) Troubled

1	2	3	4	5	6	7
I don't feel this way at all						**I feel extremely this way.**

8.) Sad

1	2	3	4	5	6	7
I don't feel this way at all						**I feel extremely this way.**

9.) Glad

1	2	3	4	5	6	7
I don't feel this way at all						**I feel extremely this way.**

10.) Cheerful

1	2	3	4	5	6	7
I don't feel this						**I feel extremely this way.**

Appendix C: Autobiographical Memory Test Form A

Participant Number: _____ Condition: _____

AUTOBIOGRAPHICAL MEMORY TEST Form A

Instructions

I am interested in your memory for events that have happened in your life. I am going to read to you some words. For each word I want you to think of an event that happened to you which the word reminds you of. The event could have happened recently (yesterday, last week) or a long time ago. It might be an important event, or trivial event.

Just one more thing: the memory you recall should be a specific event- ***an event that lasted less than a day, and occurred at a particular time and place.*** *So if I said the word "good" – it would not be OK to say, "I always enjoy a good party," because that does not mention a specific event. But it would be OK to say "I had a good time at Jane's party" (because that is a specific event). It is important to try to retrieve a different memory or event for each cue word. Let us try some words for practice:*

1. Car-
2. Tree-
3. Chair-

** Each participant should be prompted until a correct, specific memory is retrieved for at least two of the above practice words.*
Prompt: *"Can you think of a specific time? One particular episode?*

30 SECONDS PER ITEM

1) Blame
2) Calm
3) Hurt
4) Glorious
5) Sad
6) Helpless
7) Sunny
8) Fault
9) Eager
10) Proud
11) Hopeful
12) Grave
13) Guilty
14) Bored
15) Ugly
16) Pleased
17) Smile
18) Misery
19) Relieved
20) Happy

Appendix D: Autobiographical Memory Test Form B

Participant Number: _____ Condition: _____

AUTOBIOGRAPHICAL MEMORY TEST Form B

Instructions

I am interested in your memory for events that have happened in your life. I am going to read to you some words. For each word I want you to think of an event that happened to you which the word reminds you of. The event could have happened recently (yesterday, last week) or a long time ago. It might be an important event, or trivial event.

Just one more thing: the memory you recall should be a specific event- ***an event that lasted less than a day, and occurred at a particular time and place.*** *So if I said the word "good" – it would not be OK to say, "I always enjoy a good party," because that does not mention a specific event. But it would be OK to say "I had a good time at Jane's party" (because that is a specific event). It is important to try to retrieve a different memory or event for each cue word. Let us try some words for practice:*

1) Rain-
2) Newspaper-
3) Milk-

** Each participant should be prompted until a correct, specific memory is retrieved for at least two of the above practice words.*
Prompt: *"Can you think of a specific time? One particular episode?*

30 SECONDS PER ITEM

1) Friendly
2) Ashamed
3) Upset
4) Rejected
5) Awful
6) Lively
7) Lucky
8) Worse
9) Grief
10) Cheer
11) Solemn
12) Faithful
13) Hopeless
14) Amazed
15) Carefree
16) Peaceful
17) Bad
18) Devoted
19) Weakness
20) Joy

Appendix E: Autobiographical Memory Test Form A with Digits

Participant Number: _____ Condition: _____

AUTOBIOGRAPHICAL MEMORY TEST Form A

Instructions

I am interested in your memory for events that have happened in your life. I am going to read to you some words. For each word I want you to think of an event that happened to you which the word reminds you of. The event could have happened recently (yesterday, last week) or a long time ago. It might be an important event, or trivial event. Also, before I read each word I will give you a list of numbers to remember. Please do not write these down. After you have recalled the event, you will be asked to remember the numbers in order, exactly as they were read.

Just one more thing: the memory you recall should be a specific event- ***an event that lasted less than a day, and occurred at a particular time and place.*** *So if I said the word "good" – it would not be OK to say, "I always enjoy a good party," because that does not mention a specific event. But it would be OK to say "I had a good time at Jane's party" (because that is a specific event). It is important to try to retrieve a different memory or event for each cue word. Let us try some numbers and words for practice. As we go along, keep in mind that most people find this task very difficult. No one is expected to get all of the items correct. People often remember much more than they think they are remembering. Just try to do your best.*

1) *3-2-1* Car-
2) *1-3-7* Tree-
3) *5-2-9* Chair-

** Each participant should be prompted until a correct, specific memory is retrieved for at least two of the above practice words.*
Prompt: *"Can you think of a specific time? One particular episode?*

<u>30 SECONDS PER ITEM</u>

1) *3-0-7* Blame
2) *7-4-2* Calm
3) *7-0-3* Hurt
4) *1-5-9* Glorious
5) *8-9-2* Sad
6) *8-6-7* Helpless
7) *7-9-1* Sunny
8) *1-5-6* Fault
9) *3-0-8* Eager
10) *1-2-3* Proud
11) *3-6-5* Hopeful
12) *3-0-5* Grave
13) *6-5-0* Guilty
14) *8-1-4* Bored
15) *6-5-2* Ugly
16) *4-0-5* Pleased
17) *5-4-1* Smile
18) *7-1-0* Misery
19) *9-1-5* Relieved
20) *4-9-1* Happy

Appendix F: Autobiographical Memory Test Form B with Digits

Participant Number: _____ Condition: _____

AUTOBIOGRAPHICAL MEMORY TEST Form B

Instructions

I am interested in your memory for events that have happened in your life. I am going to read to you some words. For each word I want you to think of an event that happened to you which the word reminds you of. The event could have happened recently (yesterday, last week) or a long time ago. It might be an important event, or trivial event. Also, before I read each word I will give you a list of numbers to remember. Please do not write these down. After you have recalled the event, you will be asked to remember the six numbers in order, exactly as they were read.

Just one more thing: the memory you recall should be a specific event- ***an event that lasted less than a day, and occurred at a particular time and place.*** *So if I said the word "good" – it would not be OK to say, "I always enjoy a good party," because that does not mention a specific event. But it would be OK to say "I had a good time at Jane's party" (because that is a specific event). It is important to try to retrieve a different memory or event for each cue word. Let us try some numbers and words for practice. As we go along, keep in mind that most people find this task very difficult. No one is expected to get all of the items correct. People often remember much more than they think they are remembering. Just try to do your best.*

1) *3-2-1* Rain-
2) *1-3-7* Newspaper-
3) *5-2-9* Milk-
* *Each participant should be prompted until a correct, specific memory is retrieved for at least two of the above practice words.*
Prompt: *"Can you think of a specific time? One particular episode?*

<u>30 SECONDS PER ITEM</u>

1) *1-0-8* Friendly
2) *7-3-6* Ashamed
3) *0-2-6* Upset
4) *5-4-8* Rejected
5) *7-2-3* Awful
6) *6-3-8* Lively
7) *4-3-6* Lucky
8) *7-6-4* Worse
9) *4-8-6* Grief
10) *3-8-5* Cheer
11) *2-3-8* Solemn
12) *7-9-2* Faithful
13) *4-5-1* Hopeless
14) *2-4-9* Amazed
15) *9-4-0* Carefree
16) *7-2-0* Peaceful
17) *9-1-4* Bad
18) *9-8-1* Devoted
19) *3-2-4* Weakness
20) *3-0-6* Joy

Appendix G: Source Tables for Statistical Analyses

Table G1

Analysis of Variance for Manipulation Check

Source	*df*	*F*	*ss*	*ms*
Time	2	6.36**	514.91	257.45
Order	1	.002	.20	.002
Time x Order	2	68.61***	5551.51	2775.75
Error (Time)	156		6311.58	40.46
Error Between	78		18359.09	235.37

Note. * $p < .05$. ** $p < .01$. *** $p < .001$

Assumptions of homogeneity of variance and sphericity were met.

Table G2

Analysis of Variance for Autobiographical Memory Test (AMT)

Source	*df*	*F*	*ss*	*ms*
		Between subjects		
Digits	1	4.72*	162.01	162.01
Order	1	.63	21.76	21.76
Digits x Order	1	.31	10.51	10.51
Error	76		2610.68	34.35
		Within subjects		
Mood	1	4.10*	21.76	21.76
Mood x Digits	1	.52	2.76	2.76
Mood x Order	1	.52	2.76	2.76
Mood x Digits x Order	1	.01	.06	.06
Error (Mood)	76		403.16	5.31

Note. * p < .05. ** p < .01. *** p < .001

Assumptions of homogeneity of variance and sphericity were met.