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Examining a Hierarchical Linear Regression Model of Overgeneral Memory: Methodological Issues, CaR-FA-X Model Mechanisms, and Memory Encoding as Represented by Cognitive Attributional Style

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EXAMINING A HIERARCHICAL LINEAR REGRESSION MODEL OF OVERGENERAL MEMORY: METHODOLOGICAL ISSUES, CAR-FA-X MODEL MECHANISMS, AND MEMORY ENCODING AS REPRESENTED BY COGNITIVE ATTRIBUTIONAL STYLE

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ABSTRACT
EXAMINING A HIERARCHICAL LINEAR REGRESSION MODEL OF OVERGENERAL MEMORY: METHODOLOGICAL ISSUES, CAR-FA-X MODEL MECHANISMS, AND MEMORY ENCODING AS REPRESENTED BY COGNITIVE ATTRIBUTIONAL STYLE

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Overgeneral memory (OGM) is a phenomenon of reduced autobiographical memory specificity observed in major depressive disorder (MDD) and post-traumatic stress disorder (PTSD). Individuals demonstrating OGM tend to describe past events generally rather than specifically recalling single memory occurrences. Research shows that OGM is perpetuated by three mechanisms: capture in the memory hierarchy due to trait rumination (CaR), functional avoidance of specific memory retrieval (FA), and impaired executive control (X), which together make up the CaR-FA-X model of OGM. Research on the CaR-FA-X model has historically looked at each mechanism in isolation. The current research aimed to compare the contributions of all three mechanisms to a measure of OGM, as well as to investigate possible interactions between the mechanisms, and compare the contributions of the CaR-FA-X model to those of an encoding predictor. Psychometric data on the three CaR-FA-X mechanisms, autobiographical memory specificity, cognitive attributional style, and mental health were collected from 107 undergraduate psychology students via online surveys, then analyzed in a hierarchical linear regression model. Executive control explained significant unique variance in OGM, with rumination making an indirect contribution. No other anticipated contributions from the CaR-FA-X model or memory encoding were observed. Methodological issues in non-clinical and computerized OGM research are highlighted.

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LIST OF ABBREVIATIONS

AMT – Autobiographical memory test
ASQ – Attributional style questionnaire
CaR – Capture and rumination
COWAT – Controlled oral word association task
FA – Functional avoidance
MDD – Major depressive disorder
OGM – Overgeneral memory
PCL-5 – PTSD checklist for DSM-5
PHQ-9 – Patient health questionnaire-9
PTSD – Post-traumatic stress disorder
RRS – Ruminative responses scale
WAYS – Ways of coping questionnaire
X – Impaired executive control

Introduction

Cognitive attributional style, sometimes called explanatory style, is the characteristic manner in which an individual explains the cause of self-relevant events. Put in simple terms, it describes the overall way in which a particular individual assigns meaning to the events in his or her life (Abramson, Alloy, & Metalsky, 1990). Another construct of interest, overgeneral memory (OGM), relates to the specificity with which we recall the events that have happened to us (Williams, 2006). OGM occurs when we recall an event memory without sufficient detail to distinguish the memory as a single, specific instance – that is, the memory is too general. For example, if asked to recall a time when one was happy, one might respond by saying "I was happy last Saturday when I walked my dog in the park." This would not be considered an OGM because the individual has given enough information to establish that his or her happy memory occurred at a single, definite point in time (i.e., last Saturday). If the individual had instead responded by saying "I am happy when I walk my dog," it would have been considered an instance of OGM because the response does not contain specific enough information to distinguish a single point in time. The aim of the current study was to investigate the possible connection between the degree of specificity with which individuals habitually recall events in their lives (i.e., OGM) and how those individuals typically attribute meaning to the events in their lives (i.e., cognitive attributional style).

OGM is a phenomenon of reduced autobiographical memory specificity that has been associated with a number of mental illnesses (Boelen, Huntjens, & van den Hout, 2014; Ridout, Matharu, Sanders, & Wallis, 2015). First observed in suicide attempters

(Williams & Broadbent, 1986), OGM has been most extensively linked to major depressive disorder (MDD) and posttraumatic stress disorder (PTSD) (e.g., Anderson, Goddard, & Powell, 2010; Ono, Devilly, & Shum, 2015; Sumner, Griffith, & Mineka, 2010). The presence of OGM is thought to represent a potential risk factor for the development of both disorders (Bryant, Sutherland, & Guthrie, 2007; van Minnen, Wessel, Verhaak, & Smeenk, 2005). Further, OGM has been implicated in the maintenance of both MDD and PTSD, and has also been found to predict the course of both disorders (Boelen et al., 2014; Brittlebank, Scott, Williams, & Ferrier, 1993; Ono et al., 2015; Sumner et al., 2010).

In addition to being involved in the onset and maintenance of both disorders, OGM is associated with a number of skill deficits, including reduced social problem-solving abilities, poor ability to envision the future in a specific manner, and reduced ability to set specific, realistic goals, all of which point to poor outcomes in recovering from psychopathlogy (Belcher & Kangas, 2014; Boelen et al., 2014; Kaviani, Rahimi, Rahimi-Darabad, & Naghavi, 2011; Ridout et al., 2015). Conversely, training interventions aimed at improving memory specificity are associated with fewer depressive symptoms and decreased hopelessness, suggesting there may be a two-way relationship between OGM and the course of psychopathology (Raes, Willams, & Hermans, 2009; Serrano, Latorre, Gatz, & Montanes, 2004).

The CaR-FA-X Model

The predominant model of OGM is Williams' CaR-FA-X model (2007), and describes three primary mechanisms by which OGM acts: capture and rumination (CaR),

functional avoidance (FA), and impaired executive control (X). Together, these three mechanisms (CaR, FA, & X) comprise the CaR-FA-X model of OGM. Although all three mechanisms of the CaR-FA-X model have been studied independently in connection with OGM, there is no known interaction between the three mechanisms, and few studies have attempted to examine relationships between all three mechanisms (Sumner, 2012). Williams' model has foundations in Conway & Pleydell-Pearce's (2000) self-memory model, specifically focusing on top-down, or generative, memory retrieval. In order to fully appreciate the implications of the CaR-FA-X model, it is necessary to first examine the self-memory model.

Conway and Pleydell-Pearce's self-memory model. According to Conway and Pleydell-Pearce's (2000) model, generative retrieval involves an intentional staged search through a memory hierarchy, with the goal of retrieving information that matches the initial retrieval requirements. In the case of OGM studies, the information to be retrieved is a specific autobiographical memory, fitting the initial retrieval cue word, which is typically affective and strongly valenced (i.e., "happy" or "sad"). This top-down, generative method of memory retrieval occurs in response to either an internal or external request for information. This stands in contrast to bottom-up retrieval, which occurs spontaneously and unexpectedly and requires no conscious effort on the part of the person doing the remembering. OGM is often measured using the autobiographical memory test (AMT), a 10-item prompt that uses affective keywords (e.g., "happy," "sad," etc.) to elicit autobiographical memory recall (Williams & Broadbent, 1986). Response

coding for the AMT explicitly codes for memory specificity (i.e., general versus specific recall).

Conway and Pleydell-Pearce (2000) have posited that the search process in generative retrieval uses abstract "general" descriptors to search through multiple levels of memory specificity, evaluate possible memory outputs, and verify that the generated output matches the initial retrieval specifications. As such, these general descriptors are central to the generative retrieval process. In OGM, it is thought that a general descriptor used in the memory search is returned instead of an actual specific memory, thus leading to the lack of autobiographical memory specificity observed in OGM.

Such failure to return a specific memory represents a failure of the generative search, called a "dysfacilitation of the retrieval process," or aborted search. An aborted memory search terminated in the very first stages of retrieval may cause the person remembering to either fail to give a response at all (called an "omission") or else return a semantic associate of the retrieval cue. Later preemptive termination would result in the retrieval of an intermediate general descriptor that would normally be used to guide the retrieval process. Two kinds of general descriptor "memories" have been described in the OGM literature. A "categorical" memory is one that describes a class of events (i.e., "when I go to the gym") as opposed to a single specific event. By contrast, an "extended" memory is one that describes a series of events that occurred in close temporal proximity to one another, but occurred across more than one day (i.e., "my vacation in Rome"; Williams et al., 1996).

According to Conway and Pleydell-Pearce's (2000) model, a highly elaborated, interconnected network of intermediate general descriptors begins to form if generative searches are repeatedly aborted. This decreases the likelihood of accessing a specific memory for a given retrieval cue. The OGM phenomenon itself is thought to be caused by this aborted generative search process, while the mechanisms that are thought to cause the aborted search are related to cognitive processing, coping, and resource deficits that have been observed in both MDD and PTSD (Honzel, Justus, & Swick, 2014; Michl, McLaughlin, Shepherd, & Nolen-Hoeksema, 2013). The CaR-FA-X model describes these deficits.

Capture and Rumination (CaR). According to Williams' (2006) CaR-FA-X model of OGM, an individual may become "captured" at the level of intermediate general descriptors during a generative retrieval search. This phenomenon is called "mnemonic interlock" and evidence shows that this is more likely to occur when a retrieval cue activates an individual's long-term beliefs, attitudes, and concerns (Spinhoven, Bockting, Kremers, Schene, & Williams, 2007). When an individual is captured in mnemonic interlock, they cannot move to a deeper level of memory hierarchy, and thus cannot move past the general level at which they are captured, so they instead bounce between related descriptors at that level. This capture then triggers ruminative thinking. Rumination is the repeated focus on feelings of distress, with an emphasis on analyzing the causes and consequences of that distress as opposed to finding solutions to decrease the negative emotion (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Take for example someone who has failed a test for an important class. If the individual responded by ruminating

about this event, he or she might think over and over again about how bad he or she feels for failing the test. He or she might contemplate the reasons why he or she failed the test, attempting to dissect all of the factors that contributed to his or her failure. He or she might also think about how he or she will definitely fail the class now because he or she failed the test. Without searching for solutions to the problem (i.e., how to pass the next test), this line of thinking will only intensify his or her distress, leading to a cycle of increased analytical processing and distress amplification. This is rumination.

Rumination keeps the individual in mnemonic interlock by repeatedly activating the intermediate descriptors at the captured level in an attempt to analyze issues related to the individual's concerns, as triggered by the cue word. Theoretically, this would strengthen the connections between the intermediate descriptors, thereby further elaborating the network at the intermediate hierarchy levels and increasing the likelihood that OGM recall will occur again.

Studies of rumination in connection with OGM support the CaR hypothesis of the CaR-FA-X model. Measures of trait rumination correlate with the probability of retrieving a specific memory, with higher levels of rumination predicting fewer specific memories (e.g., Sumner, Griffith, & Mineka, 2011). Further, induced ruminative processing has been linked to increased OGM (Sutherland & Bryant, 2007) while induced sensory experience (i.e., non-ruminative) processing has been found to reduce OGM in non-clinical samples (Raes, Watkins, Williams, & Hermans, 2008). This suggests a causal relationship between rumination and OGM. The relationship may be

bi-directional, as induction of a non-specific memory retrieval style has also been associated with increased rumination (Raes, Hermans, Williams, Geypen, & Eelen, 2006). It can be tempting to explain the connection between rumination and OGM as the byproduct of a third variable relationship with MDD, but levels of trait rumination have been found to account for differences in ability to recall specific memories even when controlling for depressive symptoms (e.g., Wessel et al., 2014).

The role of rumination in OGM, and thus in the explanatory CaR-FA-X model, is supported by mnemonic interlock theory. Sumner et al. (2011) found that high ruminators are less likely to retrieve a specific memory than low ruminators when a cue was low on self-relevance. The same relationship did not hold true for cues high on self-relevance, suggesting that people with a high tendency to ruminate are more easily captured by mnemonic interlock. In high ruminators, cues with both higher and lower relevance to their personal concerns activated the rumination process, whereas all individuals are likely to ruminate when cues are highly relevant to their concerns (Crane, Barnhofer, & Williams, 2007).

Some studies have found further connections between OGM and the subcomponents of rumination: reflection and brooding. Reflection refers to purposeful internal thought directed at alleviating depressive symptoms, while brooding is defined as "a passive comparison of one's current situation with some unachieved standard" (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Some evidence suggests that reflection plays a 'healthy' role in recovering from MDD, whereas brooding represents a possible risk

factor for mood-related psychopathology (Burwell & Shirk, 2007; Joorman, Dkane, & Gotlib, 2006).

When looking at the reflection component of rumination, Wessel and colleagues (2014) found that higher levels of reflection were related to a higher tendency to retrieve specific positive memories in individuals with remitted depression, even when controlling for current depressive symptoms. Schoofs, Hermans, Griffith, and Raes (2013) found the opposite, with the number of specific memories recalled decreasing as the level of reflection increased following a self-discrepant thinking induction, suggesting that reflection, commonly known as the adaptive component of rumination, could actually be harmful when aimed at resolving self-discrepancies. Still other studies have found no connection between reflection and OGM (Romero, Vasquez, & Sanchez, 2014).

In examining the role of brooding and OGM, Wessel and colleagues (2014) found no connection between brooding and OGM in remitted depressives, while Romero et al. (2014) found the opposite: a higher level of brooding predicts retrieval of fewer specific positive memories. The majority of studies that report a connection between reflection and OGM have not found a relationship between brooding and OGM, and vice versa (Romero et al., 2014; Schoofs et al., 2013; Wessel et al., 2014).

Functional Avoidance (FA). The second component of the CaR-FA-X model, functional avoidance, describes a tendency for those demonstrating OGM to evade emotional distress by recalling memories with reduced specificity. For example, someone who witnessed a bomb explosion might exhibit FA in order to bypass the distress that accompanies those memories. When asked about the explosion, this person might

respond by simply saying “It was loud,” when in fact they are actually able to remember what they were wearing, what they were doing, their thoughts right before the bomb went off, as well as who they saw injured during and immediately after the blast. By avoiding thinking about these details and instead giving a generalized response, this person avoids the emotional distress associated with the bomb going off, and thus is exhibiting FA.

Williams (2006) suggests that FA develops through a developmentally learned association between greater emotional distress and greater memory specificity. This is consistent with findings that children with a more specific memory recall style tend to be more emotion-focused, and that individuals with this same style experience greater mood disturbance following induced frustration (Drummond, Dritschel, Astell, O’Carroll, & Dalgleish, 2006; Raes, Hermans, de Decker, Eelen, & Williams, 2003). In Williams’ view, this learned association between distress and memory specificity leads to subsequent development of FA in those that later experience depression or trauma (2006).

FA is thought to begin as avoidance of specific recall of trauma-related memories, which later develops into an overall overgeneral retrieval style (i.e., OGM) through repeated reinforcement (Williams et al., 2007). According to CaR-FA-X model theory, FA may be maintained through a “gating mechanism” that fights to keep negative specific memories out of consciousness by blocking recall of those specific memories (Williams, 2006). As a result, the level of intermediate descriptors is the deepest level of memory retrieval that can easily be accessed, thus leading to increased retrieval of categoric memories in individuals displaying this FA.

The FA hypothesis goes one step further in explaining the memory disturbances observed in PTSD. It posits that when both FA and reduced executive control (the "X" piece of the CaR-FA-X model) are present, an individual should experience faster output of memories through bottom-up retrieval. These memories would likely be negative specific memories that the individual has been fighting to keep out of conscious awareness through the FA gating mechanism, but cannot any longer due to impaired executive control. The phenomenological result, then, may be the involuntary, spontaneous, intrusive recall of negative memories experienced by an individual with PTSD when triggered. Indeed, there is a higher tendency for individuals with PTSD to recall a higher number of negative general memories than positive ones in OGM, suggesting that the retrieval of general memories may act as that gating mechanism to allow the individual to avoid painful specific memories (Ono et al., 2015). Similarly, individuals with adult trauma have shown a tendency to respond to threat cue words with higher levels of OGM, suggesting that FA may be at play in reducing the potential for involuntary recall of specific memories associated with the threat cue (Ono & Devilly, 2013).

As expected, measures of avoidant coping and cognitive avoidance strategies correlate with the probability of recalling a specific memory on measures of OGM (Schönfeld & Ehlers, 2006; Wessel et al., 2014). Further, the association between level of OGM and degree of FA stands independent of the association between OGM and MDD, with an increase in categoric recall immediately following an acute stress induction positively correlating with higher levels of cognitive avoidant coping in a non-clinical

sample, even after controlling for depressive symptoms (Debeer, Raes, Claes, Vrieze, Williams, & Hermans, 2012). This suggests that acute stress may spontaneously activate the FA mechanism through X (i.e., impaired executive control). In contrast to the association between categoric recall association and spontaneous activation of FA, intentional conscious suppression of specific memories is related to an increase in the number of extended memories recalled in response to word probes (Stephens, Braid, & Hertel, 2013). Since categoric recall is the typical form of OGM observed in studies of both MDD and PTSD (Ono et al., 2015), this suggests that the FA mechanism may operate outside of conscious awareness, independent of the individual's control.

Lending further support to the idea that FA may subconsciously block retrieval of potentially painful memories through categoric recall is the previously discussed finding by Schoofs et al. (2013) that the number of specific memories recalled following a self-discrepant thinking induction decreased as an individual's level of reflection increased, while number of categoric memories recalled increased. This suggests that individuals engaging in self-discrepant thinking may be subconsciously avoiding generating specific examples of those self-discrepancies, particularly in cases where reflection might make those examples more easily accessible.

Impaired e<u>X</u>ecutive control (X). Conway and Pleydell-Pearce's (2000) model suggests that generative retrieval requires a high degree of executive control to guide the search process. Executive control refers to the cognitive processes that allow for goal-directed action, such as planning, monitoring, and inhibiting irrelevant information from interfering with the task at hand (e.g., Strauss, Sherman, & Spreen, 2006).

Executive control consists of three core components: inhibitory control, cognitive flexibility, and updating working memory (Miyake et al., 2000). Inhibitory control includes response inhibition (i.e., impulse control) and cognitive inhibition, while cognitive flexibility refers to task-switching (e.g., unconsciously switching attention between changing the music on one's phone and driving) and mental set-shifting (e.g., when editing a paper, switching from thinking that the problems one needs to fix are grammatical, to thinking that they are content-related) and is closely related to creativity. Working memory describes a component of short-term memory responsible for holding information used in current processing and cognitive tasks.

All three components of executive control may be explicitly involved in the strategic memory search process (Sumner, 2012). Inhibition, the ability to focus on relevant stimuli while filtering out irrelevant ones, is necessary for ignoring information not related to the memory search task. Inhibition is also important in guiding the search process toward memories that fit the retrieval specifications. Working memory is necessary for holding the retrieval specifications and instructions to recall a "specific" memory in mind while conducting the search process. Verbal fluency, which involves cognitive flexibility, encompasses cognitive processes necessary for information and memory retrieval, such as selective attention, mental set-shifting, internal response generation, and self-monitoring (Patterson, 2011, p. 2603), and reflects the ability to organize retrieval, initiate and maintain a search set, and inhibit inappropriate responses (Swan & Carmelli, 2002). Clearly, without these processes, a strategic memory search would be difficult, if not impossible. Thus, the CaR-FA-X model suggests that

insufficient executive control may lead to an aborted search, and, in turn, OGM. This is consistent with the long-standing notion that individuals with MDD show poor memory because of a general lack of cognitive resources (Ellis & Ashbrook, 1988; Hertel & Hardin, 1990). The expectation according to the CaR-FA-X model, then, is that reduced executive control will result in slower generative retrieval and increased categoric recall due to early search termination (Williams, 2006).

Consistent with this expectation are findings that point to slower retrieval of positive memories in those with MDD (Ridout, Dritschel, Matthews, & O'Carroll, 2016). Additionally, evidence shows that higher scores on measures of executive control are positively related to the probability of recalling a specific memory (Sumner et al., 2011). This complements the finding that depletion of executive control through completion of the Stroop color word task resulted in retrieval of fewer specific memories and more categoric memories, even when depression levels were held constant (Neshat-Doost, Dalgleish, & Golden, 2008).

Although impaired executive control clearly contributes to the occurrence of OGM, the relationship between specific components of executive control and OGM is unclear. Raes, Verstraeten, Bjittebier, Vasey, & Dalgleish (2010) found that inhibitory control, mediated the relationship between MDD and OGM. Another study examining shifting, verbal fluency, and inhibition, provided evidence that category fluency – a facet of verbal fluency – was found to be the only component associated with OGM (Valentino, Bridgett, Hayden, & Nuttall, 2012). Evidence links higher levels of OGM to lower cognitive inhibition (Raes et al., 2010), working memory capacity (Neshat-Doost et al.,

2008), and verbal fluency (Heeren, Van Broeck, & Philippot, 2009), however, associations are not consistent across studies (Sumner, 2012). Compounding the issue further is the general lack of studies examining specific components of executive control and inconsistent operationalization of executive control components in OGM studies.

Autobiographical Memory Encoding and OGM

Although Williams' (2006) CaR-FA-X model offers an elegant explanation of the potential mechanisms that underlie OGM, it may not comprehensively account for all of the factors influencing OGM, as a number of findings in the literature point to phenomena outside of the explanatory scope of the CaR-FA-X model (e.g. the role of reduced goal specificity in contributing to OGM [Belcher & Kangas, 2014]; the role of somatic distress and self-esteem on OGM [Kashdan, Roberts, & Carlos, 2006]; the role of expressive writing as a protective factor against OGM [Maestas & Rude, 2012]; the relationship between maternal reminiscing style and child's autobiographical memory specificity [Valentino et al., 2014]). Most notably, the finding that the temporal remoteness of an event is associated with the probability that the memory of the event will be recalled specifically rather than overgenerally, even when accounting for CaR-FA-X variables, suggests that mechanisms affecting retrieval may not be the only ones at play in perpetuating OGM (Falco, Peynircioglu, & Hohman, 2015). Factors affecting memory encoding may also influence overgeneral recall, although comparatively less research has been completed in regards to the relationship between encoding and OGM, as it is assumed that OGM is the result of a retrieval deficit (Williams, 2006).

The current study aims to address this gap in the research by examining cognitive attributional style, and thus an individual's style of interpreting and encoding event memories, in connection with CaR-FA-X model mechanisms and autobiographical memory specificity. The idea behind examining cognitive attributional style is that OGM is perpetuated via repetitive activation of intermediate descriptors during memory retrieval (Williams, 2006). Retrieval of an event memory not only makes use of objective descriptors (i.e., "hanging out with my dad last Sunday") to find the target memory, but also subjectively assigned meanings attributed to the memories during encoding or subsequent remembering (i.e., "hanging out with my dad last Sunday made me happy"). Thus, the attributed meanings of remembered events likely play a role in generative retrieval. Otherwise, it would be impossible to index and search memories by affective retrieval cue.

This suggests that the manner in which an event is encoded may influence the specificity of subsequent retrieval. Specifically, if an individual displays a tendency to attribute meanings to events in a global, stable, internally focused manner as opposed to a specific, unstable, externally focused manner, that individual's event memories may be encoded simply as evidence for long-standing general opinions or categoric descriptor statements (e.g., "spending time alone never makes me happy"), as opposed to a specific incident exhibiting those characteristics (e.g., "I was unhappy spending time alone today"). If event memories are encoded as categoric descriptor statements, it may, in turn, increase the likelihood that those memories are recalled in a categoric, as opposed, to specific, manner.

The finding that negative event cue words elicit fewer specific responses than negative affective cue words in individuals displaying dysphoria (Rekart, Mineka, & Zinbarg, 2006) supports the assertion that categoric encoding may play a part in perpetuating OGM, as it would be easier to recall a specific memory from an affective descriptor cue than from an event cue if negative memories are encoded categorically in individuals experiencing emotional distress. Evidence also suggests that people with MDD describe life events and time periods with increased coherence and repetition of negative information, whereas individuals with no MDD experience display the opposite pattern (Dalgliesh, Hill, Golden, Morant, & Dunn, 2011), further suggesting that encoding in OGM may involve sorting memories according to pre-established negative descriptor themes, which would then guide subsequent retrieval.

Cognitive attributional style refers to the way in which individuals interpret and assign meaning to personal life events, and thus may influence the way in which events are encoded and subsequently remembered. The construct consists of three dimensions which together make up attributional style: internality, stability, and globality. Internality refers to the extent to which an individual interprets an event as being due to his or her own actions (e.g., "I dropped my lunch because I am clumsy" versus "I dropped my lunch because someone bumped into me"). Stability describes the extent to which the attributed cause for a given event will continue to affect the individual in the future (e.g., "I will always be clumsy, so I will probably drop my lunch again in the future" versus "I was clumsy because I was tired this morning, so I will not likely drop my lunch again in the future.") Finally, globality refers to the overall generalizability of the attributed cause

to other domains of life (e.g., "Being clumsy also causes me to trip, knock things over, create messes, and generally live in a disorganized, embarrassed state" versus "Being clumsy just causes me to drop things").

Cognitive attributional style has been linked to MDD in learned helplessness theory, such that an internal, stable, global attibutional style for negative events (i.e., pessimistic style) is associated with vulnerability toward developing MDD (Abramson, Seligman, & Teasdale, 1978). An external, unstable, specific attributional style for negative events (i.e., optimistic style) has also been shown to play a role in protecting against MDD relapse when combined with attributional flexibility (Moore, Fresco, Schumm, & Dobson, 2017). Further, an internal, stable, global style for positive events has been linked to decreased depressive symptoms in adolescents (Rueger & George, 2017) and resilience in the face of failure (Johnson, Panagioti, Bass, Ramsey, & Harrison, 2017). Thus, it stands to reason that cognitive attributional style may be linked to OGM as a factor influencing memory encoding and subsequent retrieval by determining a subset of retrieval cues associated with event memories, particularly memories of strong emotional valence.

Research Questions

The current study aims to examine the connection between the CaR-FA-X model variables, cognitive attributional style, and OGM. In particular:

1) Do each of the individual CaR-FA-X model mechanisms contribute significant unique variance to a measure of OGM (as measured by the AMT)?

2) Does the CaR-FA-X model as a whole contribute significant additional unique variance to AMT performance over and above the variance accounted for by the individual CaR-FA-X elements independently (as measured by the inclusion of the three two-way and the one three-way interaction terms)?

3) Does cognitive attribution account for unique variability in AMT performance not captured by the CaR-FA-X model?

Method

Participants

The participants in this study were 107 undergraduate San Jose State University psychology students between the ages of 18 and 26 (M = 19.43, SD = 1.55). The sample characteristics are shown in Table 1. The sample included slightly more males than females, with 56.07% of the sample identifying as female and 43.92% identifying as male. No students identified as transgender. All participants responded to gender identification question.

Table 1

Descriptive Statistics – Gender and Ethnicity (N = 107)

Demographic Characteristics	*N*	Percentage
Gender		
Female	60	56.07%
Male	47	43.92%
Ethnicity		
Hispanic	41	38.32%
Asian/Pacific Islander	40	37.38%
Caucasian	16	14.95%
African-American	5	4.67%
Middle Eastern	1	.93%
Native American	1	.93%
Other	3	2.8%

Note. N = Number of participants in the total sample. n = Number of participants that identified with the given group. Transgender option offered, although no participants identified as such.

The sample was ethnically diverse, reflecting the composition of San Jose State University, with 38% of participants identifying as Hispanic, 37.4% identifying as Asian or Pacific Islander, and 15.0% identifying as Caucasian. African-American participants comprised 4.7% of the sample, while Middle Eastern and Native American participants each made up 0.9% of the sample. A small portion of the participants (2.8%) identified as "other."

Target Variables and Psychometrics

Autobiographical memory specificity. Autobiographical memory specificity was measured in terms of the number of general versus specific memories recalled, with general memories being coded according to type (i.e., categoric, extended, semantic association, or omission). Autobiographical memory specificity was assessed using a computerized version of the AMT. The AMT is the standard assessment procedure used in the vast majority of OGM and autobiographical memory specificity studies (Debeer, Hermans, & Raes, 2009; Debeer et al., 2012; Heeren et al., 2009; Hitchcock, Nixon, & Weber, 2014; Neshat-Doost et al., 2008; Ono & Devilly, 2013; Ridout et al., 2016; Schoofs et al., 2013; Sutherland & Bryant, 2008; Valentino et al., 2012; Wessel et al., 2014). The standard version of the AMT is administered orally and uses five negatively and five positively valenced affective words to probe participants for a "specific memory" (i.e., a memory of one event that occurred one time, over the space of no more than one day). Participants typically have 30 seconds to verbally give their response to each cue word, and are clearly instructed to be specific in recalling events (Williams & Broadbent, 1986).

The version of the AMT used in this study was administered online, using typed responses to increase ease and accessibility of study participation and scoring, as well as to eliminate any potential Rosenthal effects. Participants were still given 30 seconds to provide a response to each cue word, as in the standard version of the AMT. A computerized version of the AMT has been shown to replicate the OGM effect, albeit, without the usual time limit employed in most AMT administrations (Rekart et al., 2006). Additionally, pilot study data comparing the standard AMT to the online administration showed no significant differences between the two test formats. As in Williams & Broadbent (1986), the five positively valenced cue words were "happy," "safe," "interested," "successful," and "surprised," while the five negatively valenced cue words were "sad," "angry," "hurt (emotionally)," "clumsy," and "lonely."

The minimal instructions version of the AMT (α = .53) used in the current study differs from the original implementation by omitting the instruction to be specific (Griffith, Sumner, Raes, Barnhofer, Debeer, & Hermans, 2012). Debeer et al. (2009) suggests that the minimal instruction version may be more sensitive to detecting OGM in sub- and non-clinical populations. Since it was expected that there would be a minimal number of participants with a history of MDD and/or PTSD diagnosis in the sample, the minimal instructions version of the AMT used in the current study included only instructions to recall a memory in connection with the cue word, with no mention of specificity; the instruction to "be specific" was omitted (Debeer, et al., 2009).

The AMT cue words were shown in an alternating order, with each positively valenced word presentation followed by a negatively valenced word. Cue words

continued in this alternating order until participants had responded to all 10 cue words. Participants were given 30 seconds to type responses to each cue word, and were automatically advanced to a blank screen at the end of 30 seconds. Participants were then instructed to push a button to advance to the next screen when they were ready for the next cue word.

All responses to the AMT were de-identified, separated from all predictor variable data, compiled into one spreadsheet, and distributed to a research assistant trained in AMT coding. To score the AMT, the investigator and one research assistant independently read each participant's response to determine specificity (see Table 2). Each response was coded as "specific" (clearly occurring one time, on one day only), "categorical" (a series, or repetition, of events), "extended" (occurring on more than one day), "semantic association" (a reference to a person, place, or thing without any event or temporal context), or "omission" (no response) according to clearly outlined coding guidelines (Ono & Devilly, 2013; Schoofs et al., 2013; Wessel et al., 2014). The investigator and the research assistant discussed any items that did not clearly fit into one of the five codes, and mutually determined appropriate coding for such items. Only responses that clearly indicated that the referenced event occurred one time, on one specific day were rated as "specific." Thus none of the disputed responses were rated as "specific." For examples of participant responses and correspondent rating categories, see Table 2.

Table 2

Definitions and Examples of AMT Memory Response Types

Memory Type	Definition	Example
1. Specific	Clearly occurring one time, on one day.	"Meeting my boyfriend on the first day of my current job."
2. Categorical	A series or class of recurring events.	"When I disappoint my mom."
3. Extended	Occurring on more than one day.	"When someone got in an argument with me and ran away for four days."
4. Semantic Association	A reference to a person, place, or thing without temporal context.	"My dad."
5. Omission	No response, or a response devoid of content.	"I can't remember."

Note. All definitions drawn from Williams and Broadbent (1986). All examples taken from participant responses.

Inter-rater reliability was calculated for both Williams and Broadbent's (1986) standard five-category coding scheme as described above, as well as for a simplified two-category coding scheme which reflects a recent trend of examining memory specificity in OGM research (Schoofs et al., 2013; Sumner et al., 2011; Sumner et al.,

2014; Wessel et al., 2014). In this two-category scheme, the number of participant responses coded as "specific" were compared to all four other memory categories, which were combined into one category and labeled "not specific." This second, binary coding scheme was examined because memory specificity (i.e., whether or not a participant's response fit the criteria for a "specific" memory) will be the criterion variable in the study's main analysis, and will be measured only in terms of the number of specific memories recalled by participants (see Table 4). The standard five-category coding scheme was included for construct validity.

Cognitive attributional style. Cognitive attributional style was measured in terms of the three attributional style dimensions: internality, stability, and globality. Attributional style was included in the analysis as three separate style dimensions, rather than by combining the three dimensions into a single style type. Cognitive attributional style was assessed using a computerized version of the attributional style questionnaire (ASQ; Dykema, Bergbower, Doctora, & Peterson, 1996). The ASQ is a self-report measure in which participants were given 12 simple, hypothetical situations followed by three questions each for a total of 36 questions. For each situation, participants were instructed to think about that situation happening to them, and then type the most probable major cause of the situation. Participants then answered three questions about each cause using an eleven-point Likert scale, with each question contributing to one of three subscales: internality, stability, and globality.

The internality subscale (α = .70) assesses the extent to which the cause is due to the participant or another person/circumstance, and is measured on a scale of 0 ("Totally due

to other people or circumstances") to 10 ("Totally due to me"). The stability subscale (α = .81) examines the extent to which the given cause will be present in the future. Stability is measured on a scale of 0 ("Will never again be present") to 10 ("Will always be present"). Finally, the globality subscale (α = .74) assesses the extent to which a given cause applies to other situations beyond the given event. Globality is measured on a scale of 0 ("Influences just this particular area") to 10 ("Influences all situations in my life"). All ASQ subscale scores were calculated by averaging within-subject single-item response scores for each participant.

CaR-FA-X model variables. In order to examine the relationship between cognitive attributional style, OGM, and the associated CaR-FA-X mechanisms, participants completed measures assessing all three components of the CaR-FA-X model.

Capture and rumination (CaR). To examine the CaR mechanism, operationalized as trait rumination, participants completed a computerized version of the ruminative responses scale (RRS; Nolen-Hoeksema & Morrow, 1991). The RRS is the standard instrument used to assess rumination in the majority of OGM studies (Debeer et al., 2009; Romero et al., 2014; Schoofs et al., 2013; Sumner et al., 2011; Wessel et al., 2014). The RRS is 22-item scale that assesses an individual's typical response to negative mood in terms of behavioral focus on self, symptoms of negative mood, and the consequences of those symptoms (α = .90). In addition to assessing overall ruminative tendencies, the scale also addresses two facets of rumination, reflection (α = .72) and brooding (α = .77). Participants responded to each question by rating each behavior on a Likert scale of 1 ("almost never") to 4 ("almost always"). RRS and subscale scores were calculated by

were calculated by averaging within-subject single-item response scores for each participant.

The brooding and reflection subscales do not additively comprise the whole RRS, rather, each subscale includes questions that address either sub-facet of rumination, while the remainder of the RRS assesses general rumination. An initial analysis included the brooding and reflection subscales in the hierarchical multiple regression, however, neither subscale score contributed significantly to the overall model. To reduce multi-collinearity, brooding and reflection subscale scores were thus not included in the final regression.

Functional avoidance (FA). To assess FA, operationalized as avoidant coping, participants completed a computerized version of the escape-avoidance subscale (α = .72) of the ways of coping questionnaire (WAYS; Folkman & Lazarus, 1988). The WAYS assesses the thoughts and actions that participants use to cope with life stresses, with the escape-avoidance subscale specifically focusing on wishful thinking and cognitive-behavioral efforts to avoid stressors. The escape-avoidance subscale consists of 8 items, rated on a four-point Likert scale from 0 ("Does not apply or not used") to 3 ("Used a great deal"). WAYS escape-avoidance subscale scores were calculated by averaging within-subject single-item response scores for each participant.

Impaired executive control (X). To examine the X mechanism, operationalized as verbal fluency, participants completed the controlled oral word association task (COWAT; Strauss et al., 2006). The COWAT is a measure of verbal fluency and has been shown to relate to autobiographical memory specificity as a measure of executive

control in OGM studies (Sumner et al., 2011). To complete the COWAT, participants named as many words as possible starting with the letters "A," "F," & "S," each within a 60 second interval. Participants were advised that names and responses with the same stem as a previous response would not be counted. COWAT scores were calculated by averaging the number of words generated within-subject across all three letter prompts.

CaR-FA-X model interactions. To examine the CaR-FA-X model mechanisms in conjunction with one another, three two-way interactions and one three-way interaction term were calculated using the within-subject mean single-item response scores for each of the three CaR-FA-X model variables. All three variables were first centered around their respective means by subtracting the single-item response sample mean from each individual's single-item response mean to reduce the impact of multi-collinearity in the analysis. Interaction terms were then calculated by multiplying the respective CaR-FA-X model variables to produce the following terms: trait rumination x avoidant coping (CaR-FA interaction), trait rumination x verbal fluency (CaR-X interaction), avoidant coping x verbal fluency (FA-X interaction), and trait rumination x avoidant coping x verbal fluency (CaR-FA-X interaction).

Symptoms of related psychopathology. In order to examine the relationship between cognitive attributional style, OGM, CaR-FA-X model variables, and sub-clinical depressive and post-traumatic symptomatology, participants also completed computerized measures assessing recent experience of symptoms common to MDD and PTSD. Each measure is described below.

MDD symptomatology. A computerized version of the Patient Health Questioinnaire-9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001) was used to measure frequency of depressive symptoms within the past two weeks. The instrument consists of a single scale (α = .89) featuring nine questions regarding recent experience of different depressive symptoms, answered on a Likert scale of 0 "Not at all" to 3 "Nearly every day." The instrument manual suggests using scores of 5, 10, 15, and 20 as cutoff scores for mild, moderate, moderately severe, and severe depression, however, for the purposes of this study, scores were only used in their raw format, and not as the basis for creating comparison groups. While sum scores were used to describe the sample in terms of depressive symptomatology, the PHQ-9 score used in the analysis was calculated by averaging within-subject single-item response scores for each participant.

PTSD symptomatology. PTSD symptomatology was assessed using a computerized version of the PTSD Checklist for DSM-V (PCL-5; Weathers, Litz, Keane, Palmieri, Marx, & Schnurr, 2013). Participants answered 20 questions regarding the extent to which they were affected by post-traumatic stress symptoms within the past month using a Likert scale format of 0 "Not at all" to 4 "Extremely." As with the PHQ-9, scores were only used in their raw, format (α = .94). Sum scores on the PCL-5 were calculated to describe the sample in terms of post-traumatic stress symptomatology, however the scores used in the analysis were calculated by averaging within-subject single-item response scores for each participant. To calculate the participant scores in the analysis, all PCL-5 questions that were duplicated in the PHQ-9 were excluded from the PCL-5 score calculation in order to reduce multi-collinearity between measures of MDD and PTSD

symptomatology, as well as to isolate exclusively trauma-associated symptoms from mood-related symptoms common to both disorders. Administration of the PCL-5 in this study further differed from typical administration in that the standard instrument assesses trauma-related symptomatology in connection with one stressful event or set of events that is identified by the participant (i.e., Criterion A) prior to completing the Likert scale portion of the PCL-5. In the current study, participants did not identify a stressful event before reporting symptoms via Likert scale, and thus were not instructed to complete the Likert scale with any particular stressful incident in mind.

Procedure

Participants completed all measures online via Qualtrics. Participants first completed the COWAT to prevent fatigue effects from influencing the measurement of typical executive control. Participants then completed the AMT prior to completing the rumination, FA, symptomatology, and attributional style measures in order to prevent fatigue effects from influencing the quality of memory responses given. Following administration of the AMT, participants completed the ASQ, followed by the RRS and the WAYS escape-avoidance scale. Participants then completed the MDD and PTSD symptomatology measures (PHQ-9 and PCL-5), followed by a short demographic questionnaire. Participants signed electronic consent forms prior to administration.

Before performing the analysis, the participant response data was filtered to exclude scores for participants who did not complete all seven measurements, as well as to exclude scores for participants who showed no response variance on one or more of the seven measures (e.g., answering “2” on the Likert scale for every question on the PCL-5).

Results

AMT Inter-Rater Reliability

Reliability ranged from moderate to perfect, depending on the coding scheme. When the raters coded responses according to the five-category method, inter-rater reliability across all 10 word probes ranged from .42 to .58 (M = .50, SD = .06). This is a moderate level of agreement, and is above the minimum acceptable level for inter-rater agreement (Cohen, 1960). When responses were coded according to the two-category method, reliabilities ranged from .53 – 1.00 (M = .78, SD = .19), showing moderate to perfect agreement (Cohen, 1960). Reliabilities for each word probe are shown in Table 3.

Table 3

Inter-Rater Reliability by AMT Word Probe (N = 107)

AMT Word Probe	Memory Type Reliability	Specificity Reliability
1. Happy	.42	.63
2. Sorry	.54	.69
3. Safe	.49	.62
4. Angry	.50	1.00
5. Interested	.57	1.00
6. Clumsy	.42	.78
7. Successful	.45	.53
8. Hurt (Emotionally)	.47	1.00
9. Surprised	.58	.58
10. Lonely	.52	1.00

Note. All reliabilities calculated as Cohen's kappa. "Memory Type Reliability" refers to Williams and Broadbent's (1986) scheme by which participant responses were coded according to the type of memory recalled (i.e., specific, categoric, extended, semantic association, or omission). "Specificity Reliability" refers to a simplified scheme by which responses were coded as either "specific" or "not specific."

Descriptive Statistics

The mean numbers of within-participant occurrences of each memory response type are provided in Table 4, along with standard deviations. The data from the two raters were averaged into aggregate scores for each participant. These aggregate mean scores were used as the criterion variable in the hierarchical multiple correlation regression analysis.

According to the standard AMT coding scheme, participants gave more specific memory responses than any other type (M = 3.71, SD = 2.73). Categoric memories (M = 2.28, SD = 1.76) and semantic associations (M = 1.57, SD = 1.96) were more common than extended memories (M = .82, SD = .87). There were few omissions (M = .19, SD = .42), and since an omission signifies a lack of response, omissions were excluded from the "nonspecific" category in the binary coding scheme. The general level of memory specificity in the sample, as signified by the number of specific memory responses on the AMT, was in line with recent validation data for the instrument although more response variation was observed in the current sample (specific memory M = 3.70, SD = .05; Heron, Crane, Gunnell, Lewis, Evans, & Williams, 2012). Average memory specificity in the current sample was lower, however, than the level of specificity observed during the first use of the minimal instructions AMT (specific memory M = 6.36, SD = .24; Debeer et al., 2009).

Table 4

Within-Participant Occurrences of Observed AMT Memory Types by Rater (N = 107)

Memory Type	Rater 1		Rater 2		Aggregate	
5-Category	*M*	*SD*	*M*	*SD*	*M*	*SD*
Specific	3.98	2.91	3.45	2.72	3.71	2.73
Categorical	2.42	2.09	2.14	1.80	2.28	1.76
Extended	.86	1.10	.77	.87	.82	.87
Semantic Association	1.08	1.73	2.05	2.34	1.57	1.96
Omission	.27	.59	.11	.36	.19	.42
2-Category						
Specific	3.98	2.91	3.45	2.72	3.71	2.73
Nonspecific	4.37	2.99	4.96	3.01	4.67	2.91
Positive Word Probe						
Specific	1.96	1.52	1.70	1.49	1.83	1.44
Nonspecific	2.23	1.60	2.23	1.60	2.23	1.60
Negative Word Probe						
Specific	2.02	1.60	1.74	1.54	1.88	1.51
Nonspecific	2.14	1.62	2.45	1.64	2.30	1.56

Note. *M* = mean, *SD* = standard deviation. Means and standard deviations listed in this table reflect the mean number of times each memory type occurs across a single participant. The aggregate data consists of an average of the data from rater 1 and rater 2 across participants. The aggregate data were used in all hypothesis testing.

When comparing specific to nonspecific responses, participants gave significantly more nonspecific responses ($M = 4.67$, $SD = 2.91$) than specific ones ($M = 3.71$, $SD = 2.73$; $t = -2.43$, $p < .05$). Participants also gave more nonspecific responses to both positive ($M = 2.23$, $SD = 1.60$) and negative ($M = 2.30$, $SD = 1.56$) word probes than

specific ones (positive: $M = 1.83$, $SD = 1.44$; negative: $M = 1.88$, $SD = 1.51$); however the differences were not statistically significant (positive: $t = -1.83$, $p = .07$; negative: $t = -1.88$, $p = .06$).

Scores on the three CaR-FA-X model variables are summarized in Table 5. Overall, participants reported engaging in ruminative behavior "sometimes" (single-item $M = 1.91$, $SD = 1.08$; total $M = 50.67$, $SD = 15.85$), with the tendency remaining consistent across the brooding (single-item $M = 2.02$, $SD = 1.16$; total $M = 12.20$, $SD = 3.84$) and reflection (singe-item $M = 2.06$, $SD = .75$; total $M = 10.32$, $SD = 3.75$) subscales. The only normative data available for the RRS comes from a Japanese sample of female university students who were validating a translation of the instrument. The overall sample mean of this study was greater than the mean of the normative sample, although brooding and reflection scores were similar (normative sample RRS $M = 41.92$, $SD = 13.00$; brooding $M = 10.25$, $SD = 3.61$; reflection $M = 9.15$, $SD = 3.27$; Hasegawa, 2013).

Participants reported a moderate degree of avoidant coping (single-item $M = 2.39$, $SD = .58$) on the WAYS escape-avoidance scale, suggesting that participants "somewhat" engage in avoidant coping. The overall sample mean score on the escape-avoidance scale ($M = 19.21$, $SD = 5.45$) was much higher than the normative data for the scale ($M = 3.18$, $SD = 2.48$; Folkman & Lazarus, 1988). COWAT responses were counted and scored, with participants averaging 12.56 words per letter probe ($SD = 4.50$), with a mean total of 37.72 words across all three letter probes ($SD = 13.56$). This is below the most recent normative COWAT score for adults under the age of 40 ($M = 43.51$, $SD = 5.44$), but above the normative score for adults without a college education ($M = 30.07$, $SD = 13.09$;

Loonstra, Tarlow, & Sellers, 2001). This suggests that the sample's average COWAT score was within a normal range given the mean sample age and undergraduate status.

Table 5

Descriptive Statistics – CaR-FA-X Model Variables (N = 107)

Scale	*M* (Single-item)	*SD* (Single-item)	*M* (Total)	*SD* (Total)
RRS	1.91	1.08	50.67	15.85
Brooding	2.02	1.16	12.20	3.84
Reflection	2.06	.75	10.32	3.75
WAYS Escape-Avoidance	2.39	.58	19.21	5.45
COWAT	12.56	4.50	37.72	13.56

Note. The brooding and reflection subscales together do not comprise the full RRS. *M* = Mean. *SD* = Standard deviation. Means and standard deviations listed in this table reflect the average score per item on each instrument listed.

Participant scores on the memory-encoding variable (i.e., cognitive attributional style) are summarized in Table 6. Average participant scores on the internality subscale indicated a tendency to see the cause of events as more internal (i.e., more due to themselves than other people or circumstances [single-item $M = 6.55$, $SD = 1.29$; total $M = 79.74$, $SD = 14.22$]). Overall, participants tended to see the causes of given events on the ASQ as being moderately stable (single-item $M = 5.60$, $SD = 1.48$; total $M = 67.37$, $SD = 17.57$), suggesting that the causes identified by participants may or may not be present in the future. Participants tended to lean toward a slightly more global view of their own identified event causes (single-item $M = 5.88$, $SD = 1.57$; total $M = 71.23$,

18.54), indicating that they believed that those causes were likely to influence other areas of their lives. Average participant scores on the ASQ in the current sample were much higher than those of the sample used to validate the instrument, suggesting that the overall sample demonstrated a more pessimistic attributional style than average (internality *M* = 23.50, *SD* = 3.30, stability *M* = 15.30, *SD* = 5.20, globality *M* = 19.20, *SD* = 4.30; Travers, Creed, & Morrissey, 2015).

Table 6

Descriptive Statistics – Attributional Style Questionnaire (N = 107)

Scale	*M* (Single-item)	*SD* (Single-item)	*M* (Total)	*SD* (Total)
Internality	6.55	1.29	79.74	14.22
Stability	5.60	1.48	67.37	17.57
Globality	5.88	1.57	71.23	18.54

Note. *M* = Mean, *SD* = Standard deviation.

Participant average scores on the MDD and PTSD symptomatology control variables are shown in Table 7 below. The PHQ-9 suggests scores of 5, 10, 15, and 20 as cutoffs representing mild, moderate, moderately severe, and severe depression respectively (Kroeneke at al., 2001). The sample overall showed a mild to moderate level of depressive symptomatology according to these cutoffs (*M* = 9.54, *SD* = 7.52). In fact, the sample mean was significantly higher than the suggested cutoff score for mild depression, $t(106) = 6.19$, $p<.001$. On the PCL-5, a score of 33 or above suggests possible PTSD. The sample mean was below this cutoff, with wide variation in scores (*M* = 25.92,

SD = 22.71). For the PCL-5, the sample mean was significantly lower than the suggested cutoff score, $t(106) = -3.09$, $p<.01$.

Table 7

Descriptive Statistics – MDD and PTSD Symptomatology (N = 107)

Scale	*M* (Single-item)	*SD* (Single-item)	*M* (Total)	*SD* (Total)
PHQ-9	1.06	.84	9.54	7.52
PCL-5	1.30	1.14	25.92	22.71

Note. *M* = Mean, *SD* = Standard deviation. Descriptive statistics in this table refer to the average overall score for each instrument.

Since OGM has been most prominently observed in individuals with MDD and PTSD, information on participants' pre-existing mental health diagnoses and treatment was also collected (see Table 8 below). Seven participants (6.5% of the total sample of 107) identified as having been diagnosed with MDD, one identified as having been diagnosed with PTSD, and an additional six reported being diagnosed with a mental health condition other than MDD or PTSD. Overall, 15.0% of the sample (six individuals) said they had received some kind of mental health treatment in the past. Three participants said they were currently taking medication for a mental health condition, and eight reported that they were currently experiencing symptoms of their mental health condition.

Table 8

Descriptive Statistics – Participant Mental Health Conditions and Treatment (N = 107)

Mental Health Characteristics		*N*	Percentage
MDD Diagnosis			
	Yes	7	6.54%
	No	100	93.46%
PTSD Diagnosis[a]			
	Yes	1	.95%
	No	104	99.05%
Other Diagnosis			
	Yes	6	5.61%
	No	101	94.39%
Previous Treatment[a]			
	Yes	16	14.95%
	No	90	84.91%
Currently Taking Medication[a]			
	Yes	3	2.80%
	No	103	97.17%
Currently Experiencing Symptoms			
	Yes	8	7.48%
	No	99	92.52%

Note. *N* = Number of participants in the whole sample. *n* = Number of participants that identified with the given statement. [a]For items marked with this superscript, at least one participant response was missing.

Comparing the self-report mental health data with the PHQ-9 and PCL-5 scores, there appear to be higher levels of mental health symptomatology in the sample than directly reported by participants, particularly depressive symptomatology. Examination of the quartile cut points for both measures revealed that, although few participants reported a formal mental health diagnosis, over half the sample scored above the suggested cutoff for mild depression, while about one third of the sample scored above the suggested cutoff for possible PTSD (see Table 9). This confirms, then, that the average PHQ-9 and PCL-5 scores in the sample were not due to a few extremely high scores. Rather, the sample more closely approximated a clinical sample than originally anticipated.

Table 9.

Quartile Cut Points – PHQ-9 and PCL-5 Sample Scores (N = 107)

	Percentile		
Scale	25th	50th	75th
PHQ-9	3.00	9.00	16.00
PCL-5	6.75	17.00	42.00

Note. *N* = Number of participants in the whole sample. Quartile cut-off scores are total scale scores.

Hierarchical Linear Multiple Regression Analysis

A four-step hierarchical multiple regression correlation was conducted in order to explore the relationship between OGM, the CaR-FA-X model variables, and cognitive attributional style. The independent variables are divided into the following groups: mental health variables, individual CaR-FA-X model variables, CaR-FA-X model

two- and three-way interaction terms, and cognitive attributional style variables. Table 10 provides a correlation matrix describing the zero-order relationships between all 12 independent predictor variables and the criterion variable – OGM. Examination of the residuals from the multiple regression analysis confirmed that the data were normally distributed (*skewness* = -.24, *kurtosis* = -.81).

In examining the zero-order correlations, all predictor variables, with the exception of executive control and internality, appear highly correlated with one another. Of course, it is expected that rumination, functional avoidance, and executive control would be correlated with the four CaR-FA-X model interaction terms, despite attempting to reduce multi-collinearity through mean-centering the mechanism scores before creating the interaction terms. Surprisingly, however, only executive control and the three CaR-FA-X model interaction terms containing executive control (i.e., CaR-FA-X, CaR-X, and FA-X) were significantly correlated with OGM (executive control, $r = .38$, $p<.001$; CaR-FA-X interaction, $r = .29$, $p<.001$; CaR-X interaction, $r = .36$, $p<.001$; FA-X interaction, $r = .30$, $p<.001$).

Table 10.

Pearson Correlations of Criterion and Predictor Variables (N = 107)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. MDD Symptomatology	--											
2. PTSD Symptomatology	.86***	--										
3. Rumination (CaR)	.73***	.76***	--									
4. Functional Avoidance (FA)	.34***	.43***	.42***	--								
5. Executive Control (X)	.02	.00	.11**	.17*	--							
6. CaR-FA-X Interaction	.18*	.22*	.26**	.27**	.45***	--						
7. CaR-FA Interaction	.24**	.28**	.23**	.36***	.17*	.46***	--					
8. CaR-X Interaction	.70***	.68***	.92***	.43***	.34***	.44***	.32***	--				
9. FA-X Interaction	.19*	.23**	.30***	.66***	.84***	.57***	.35	.50***	--			
10. Internality	.20*	.15	.06	-.16*	.00	-.11	.02	.03	-.12	--		
11. Stability	.41***	.38***	.42***	.05	.07	.08	.02	.41***	.10	.25**	--	
12. Globality	.34***	.34***	.38***	.18*	.15	-.05	.01	.36***	.18*	.29***	.45***	--
13. Autobiographical Memory Specificity	-.05	-.09	.10	-.03	.38***	.27**	-.06	.22**	.30***	.04	.03	-.02

Note. * p≤.05, ** p≤.01, ***p≤.001.

The overall relationship between the predictors and autobiographical memory specificity in step one was not significant [$R^2 = .01$, $R^2_{Adj} = -.01$, $F(2, 103) = .55$, $p = .58$], as shown in Table 11. Therefore, MDD symptomatology and PTSD symptomatology were not significantly related to OGM, although they were included in the analysis as control variables based on prior research.

At step two, however, the relationship between the predictors and the criterion was significant [$R^2 = .20$, $R^2_{Adj} = .16$, $F(5, 98) = 4.90$, $p<.001$]. Thus, the individual CaR-FA-X model variables were significantly related to autobiographical memory specificity, as is consistent with prior research. The change in R^2 between steps one and two was also significant ($\Delta R^2 = .19$, $\Delta F = 7.74$, $p<.001$) therefore, the individual CaR-FA-X model predictors had a significant incremental effect on OGM over and above that of the non-significant mental health predictors in step one.

The overall relationship between the added predictors in step three and autobiographical memory specificity was also significant [$R^2 = .26$, $R^2_{Adj} = .19$, $F(4, 94) = 3.66$, $p<.001$]. Thus the four collective interaction term variables were significantly related to autobiographical memory specificity. The change in R^2 between steps two and three, however, only approached significance ($\Delta R^2 = .06$, $\Delta F = 1.79$, $p = .12$). The CaR-FA-X model interaction terms might have demonstrated a significant effect on OGM over and above that of the individual CaR-FA-X model mechanisms given a larger sample size.

Table 11.

Hierarchical Multiple Regression Results, Standardized Coefficients, and Pearson Correlations (N = 107)

Variable	R	β	t	sr^2	Tolerance	R	R^2	R^2_{Adj}	F	ΔR^2	ΔF
Step 1 – Mental Health Variables	--	--	--	--	--	.10	.01	-.01	.55	.01	.55
1. MDD Symptomatology	-.05	.11	.56	.05	.26	--	--	--	--	--	--
2. PTSD Symptomatology	-.09	-.18	-.93	-.09	.26	--	--	--	--	--	--
Step 2 – Individual CaR-FA-X Model Variables	--	--	--	--	--	.44	.20	.16	4.90^{***}	.19	7.74^{***}
3. Rumination	.10	.32	2.24^{*}	.20	.38	--	--	--	--	--	--
4. Functional Avoidance	-.03	-.10	-1.01	-.09	.77	--	--	--	--	--	--
5. Executive Control	$.38^{***}$	.36	3.91^{**}	.35	.94	--	--	--	--	--	--
Step 3 – CaR-FA-X Model Interaction	--	--	--	--	--	.51	.26	.19	3.66^{***}	.06	1.79
6. CaR-FA-X Interaction	$.27^{**}$	.07	.45	.04	.34	--	--	--	--	--	--
7. CaR-FA Interaction	-.06	-.17	-1.62	-.14	.69	--	--	--	--	--	--
8. CaR-X Interaction	$.22^{**}$	.39	1.12	.10	.07	--	--	--	--	--	--
9. FA-X Interaction	$.30^{***}$	.77	.95	.08	.01	--	--	--	--	--	--
Step 4 – Cognitive Attributional Style	--	--	--	--	--	.53	.28	.19	2.98^{***}	.02	.95
10. Internality	.04	.15	1.52	.13	.76	--	--	--	--	--	--
11. Stability	.03	-.07	-.58	-.05	.63	--	--	--	--	--	--
12. Globality	-.02	-.09	-.79	-.07	.66	--	--	--	--	--	--

Note. $^{***}p \leq .001$, $^{**}p \leq .01$, $^{*}p \leq .05$. All values are for the step in which the variables were entered.

The overall relationship in step four was significant as well [R^2 = .28, R^2_{Adj} = .19, F(3, 91) = 2.98, p<.01]. Therefore, the cognitive attributional style dimensions are significantly related to autobiographical memory specificity. The change in R^2 between steps three and four was not significant (ΔR^2 =.02, ΔF = .95, p = .64), therefore the cognitive attributional style dimensions did not have a significant effect on OGM over and above that of the mental health and CaR-FA-X model variables.

Tolerance and beta statistics for each of the variables can be found in Table 11. Although executive control and the three associated CaR-FA-X model interaction terms were significantly correlated with autobiographical memory specificity, only executive control made a significant unique individual contribution (β = .36, p<.001), accounting for 35% of the observed variance in autobiographical memory specificity at step 2. Executive control was related to autobiographical memory specificity such that higher levels of executive control were related to higher levels of autobiographical memory specificity.

The three-way CaR-FA-X model interaction term was significantly correlated with MDD symptomatology (r = .18, p<.05), PTSD symptomatology (r = .22, p<.05), rumination (r = .26, p<.01), FA (r = .27, p<.01), and executive control (r = .45, p<.001), likely reflecting the inter-correlations of each of the three individual variables that contributed to the interaction term. Indeed, both rumination and FA were significantly correlated with MDD symptomatology (rumination, r = .73, p<.001; FA, r = .34, p<.001) and PTSD symptomatology (rumination, r = .76, p<.001; FA, r = .43, p<.001). Thus, it is unsurprising that the CaR-FA-X model interaction term was also significantly correlated

with these variables. A similar case can be made for the correlational relationships between the CaR-X and FA-X interactions and the other predictor variables (see Table 10).

In examining the unique contributions of each predictor to the analysis, only rumination ($\beta = .32$, $t = 2.24$, $p<.05$) and executive control ($\beta = .36$, $t = 3.91$, $p<.001$) made significant contributions. Although they were significantly correlated with autobiographical memory specificity, the interaction terms containing executive control did not significantly contribute to the analysis (CaR-FA-X: $\beta = .07$, $t = .45$, $p = .66$; CaR-X: $\beta = .39$, $t = 1.12$, $p = .26$; FA-X: $\beta = .77$, $t = .95$, $p = .35$). This, taken together with the insignificant change in R^2 at step 3 suggests that the variance that would have been accounted for by the CaR-FA-X model interaction term was already accounted for by the other predictors in the study, thus the CaR-FA-X model interaction cannot uniquely account for the observed variance in OGM.

Rumination made a significant contribution to the analysis, accounting for 20% of the variance observed in step 2, despite not being significantly correlated with the criterion variable. This suggests that rumination is likely a suppressor variable, and thus does not directly explain variance in autobiographical memory specificity, but instead may explain variance in the criterion through another variable. Examining further, rumination was significantly correlated with the CaR-FA-X model interaction terms (CaR-FA-X, $r = .27$, $p<.01$; CaR-X, $r = .22$, $p<.01$; FA-X, $r = .30$, $p<.001$), which were significantly related to OGM, but did not make a significant contribution to the analysis. However, rumination made a significant contribution to the analysis before the CaR-FA-X interactions were

entered into the model. It seems, then, that rather than explaining variance in autobiographical memory specificity by explaining variance in any of the three CaR-FA-X model interaction terms containing executive control, rumination explains variance in autobiographical memory specificity by explaining variance in executive control itself.

Executive control was the only variable that both had a significant Pearson correlation with OGM and significantly contributed to the analysis, suggesting that executive control is related to autobiographical memory specificity and directly explains a portion of the variance, such that a higher level of executive control is associated with a higher level of autobiographical memory specificity.

Discussion

The primary purpose of the study was to explore the well-known relationship between mental health symptomatology (i.e., MDD and PTSD), mechanisms impacting memory retrieval (i.e., the CaR-FA-X mechanisms), and autobiographical memory specificity in light of a possible additional relationship between autobiographical memory specificity and memory encoding (i.e., cognitive attributional style). To examine these relationships, mental health (MDD and PTSD symptomatology) and CaR-FA-X model predictors (rumination, functional avoidance, executive control, and the CaR-FA-X model interaction term) were compared with an encoding predictor (the three cognitive attributional style scales: internality, stability, and globality) in a four-step hierarchical multiple regression analysis. The following three questions guided this exploratory study:

1) Do each of the individual CaR-FA-X model mechanisms contribute significant unique variance to a measure of OGM (the AMT)?
2) Does the CaR-FA-X model as a whole contribute significant additional unique variance to AMT performance over and above the variance accounted for by the CaR-FA-X elements independently?
3) Does cognitive attribution account for unique variability in AMT performance not captured by the CaR-FA-X model?

MDD and PTSD Symptoms

Few, if any, previous studies have examined the contributions of all three CaR-FA-X model mechanisms to autobiographical memory specificity, in comparison to one another. This is interesting because the findings of the present study differ from the

majority of OGM research in a number of ways. First, while most studies show a relationship between the CaR-FA-X model mechanisms and autobiographical memory specificity independent of MDD or PTSD status, virtually all previous OGM research does provide evidence of a relationship between OGM and symptoms of these two disorders (Anderson et al., 2010; Ono et al., 2015; Sumner et al., 2010). Although the current study did not specifically seek to examine the connection between OGM and mental health variables, step one of the hierarchical multiple regression analysis was comprised of MDD and PTSD symptom measurements in order to control for the effect of these variables on autobiographical memory specificity. It is interesting to note, then, that the current study did not support this substantiated connection between OGM and MDD or PTSD symptomatology.

One possible reason for this surprising finding may be an incompatibility between the diagnostic composition of the study sample and the version of the AMT used to detect OGM in this study. As expected, very few participants reported a diagnosis of MDD or PTSD. However, the average participant score on the PHQ-9 (measure of MDD symptomatology) fell close to the suggested moderate depression cutoff score, while about one third of the sample scored above the suggested possible PTSD cutoff score on the PCL-5. This suggests that participants in the current study experienced a greater number of MDD and PTSD symptoms than the self-reported diagnostic statistics would otherwise have indicated. This raises the concern that there may have been a number of participants with undiagnosed, clinical levels of MDD and/or PTSD present in the sample.

A possible explanation for the unforeseen levels of MDD and PTSD symptomatology observed in the current sample is that the reported symptoms may have been circumstantial. The study was administered during the three weeks leading up to, and encompassing, finals week. Since the sample was comprised entirely of undergraduate psychology students, many of the reported MDD and PTSD symptoms (e.g., trouble sleeping, difficulty concentrating, etc.) may have been due to the stress of finals rather than undiagnosed psychopathology. Further, since the sample was ethnically diverse, the political climate in the United States at the time of the study administration may also have played a role in increasing reported MDD and PTSD symptomatology (i.e., fear that immigrant students themselves and/or families of immigrant students may be forcibly removed from the country). Although both of these stressful conditions may have contributed to the observed levels of MDD and PTSD symptomatology in the study, it is still important to consider how these relatively high levels of observed mental health symptomatology may have impacted the results of the regression analysis.

It is possible that the lack of observed relationship between the mental health symptomatology variables and OGM may have been due to measurement error. The version of the AMT used in this study (the minimal instructions AMT) has been specifically shown to detect OGM in non-clinical samples (i.e., samples comprised largely of individuals with few symptoms of MDD and/or PTSD). The results of the present study, then, are unsurprising because this more sensitive version of the AMT likely detected the OGM phenomenon in participants both with and without subclinical symptoms of MDD or PTSD at similar levels. Further, the use of an over-sensitive

measure (i.e., the standard AMT) in non-clinical samples has been shown to produce a ceiling effect in which observed autobiographical memory specificity is so high that the relationship between OGM and depressive symptomatology disappears. The opposite appears to have happened in the current sample, with an under-sensitive measure designed for use in non-clinical samples (i.e., the minimal instructions AMT) producing a floor effect in a sample that more closely approximated a clinical one. This may have contributed to the lack of observed relationship between OGM and the mental health variables.

Individual Contributions of CaR-FA-X Model Mechanisms

The results of the present study further differed from previous research on the CaR-FA-X model in that, of the individual CaR-FA-X model mechanisms, only executive control significantly explained unique variance in OGM. Previous studies of autobiographical memory specificity have found that rumination and executive control, especially, are robustly related to the OGM phenomenon. There is comparatively less support for the relationship between FA and OGM (Sumner, 2012). Thus, it is startling that the direct connections between the CaR and FA mechanisms and OGM were not supported in the current study.

Capture and Rumination (CaR). The majority of OGM research suggests a strong, if not causal, relationship between rumination and autobiographical memory specificity (Spinhoven et al., 2007). In the present study, however, rumination appeared to indirectly contribute unique variance to autobiographical memory specificity through explaining variance in executive control rather than by directly explaining variance in OGM. One

possible reason for this result may lie in the discrepancy between the minimal instructions version of the AMT used in this study and high number of PHQ-9 and PCL-5 scores indicating latent clinical levels of MDD and PTSD symptomatology.

The minimal instructions AMT was designed for use in non-clinical samples, since the standard AMT was insufficiently sensitive to detect OGM in these samples (Debeer et al., 2009). When using the standard AMT in non-clinical samples, researchers routinely observed a ceiling effect, with participants retrieving too many specific memories to detect the OGM phenomenon. When this ceiling effect occurred, OGM's characteristic correlations to depressive symptoms and rumination – which are virtually always observed in clinical populations – could not be detected either (Raes, Hermans, Williams, & Eelen, 2007; Raes et al., 2006). When the minimal instructions AMT is used in non-clinical populations, both the OGM phenomenon and the typical correlations are clearly observed (e.g., Debeer et al., 2009).

Since the sample consisted entirely of undergraduate psychology students, it was expected that the sample would resemble typical non-clinical samples and thus the minimal instructions AMT was deemed most appropriate to measure autobiographical memory specificity in the given sample. Closer examination of the sample's distribution of PHQ-9 and PCL-5 scores after data collection revealed that, in terms of mental health symptom severity, the sample more closely resembled a clinical sample than a non-clinical one. Few, if any, studies have examined the use of the minimal instructions AMT in a clinical population. However, it stands to reason that the minimal instructions AMT may have been too sensitive to the OGM phenomenon in the given sample. Thus, it

may have failed to distinguish clinical levels of OGM from non-clinical OGM. This may have created a floor effect, where most participants gave too few specific responses, leading to a lack of observed relationship between OGM and the MDD symptomatology and rumination variables.

Despite the lack of direct relationship between trait rumination and autobiographical memory specificity, an indirect relationship was observed in the hierarchical analysis. Rumination explained significant variance in autobiographical memory specificity. Additionally, rumination was significantly related to MDD and PTSD symptomatology. None of these variables were significantly related to autobiographical memory specificity, likely for the reasons described above. However, an alternative interpretation for the lack of direct connection between OGM and rumination is that there may be a possible meditational relationship. Trait rumination may mediate the relationship between one or both of the mental health variables and OGM. Sutherland and Bryant's (2007) finding that rumination mediates the relationship between depression and OGM supports this interpretation.

Another possible interpretation is that rumination contributed significant variance to autobiographical memory specificity by acting as a suppressor variable. As previously mentioned, rumination was significantly related to executive control. It was the only variable that was related to autobiographical memory specificity while also making a significant contribution to the analysis. Rumination was also related to the three CaR-FA-X interaction terms containing executive control, which were significantly related to autobiographical memory specificity without making a unique contribution to

the model. It is tempting to reason that rumination contributed unique variance to autobiographical memory specificity through influencing one of these interaction terms. However, since rumination was entered into the model prior to these variables and appeared to make a significant contribution at step 2, this is likely not the case. Rumination may, instead, have contributed to the analysis by accounting for variance in executive control.

As mentioned previously, few studies have examined the CaR-FA-X model components in connection with one another. No known studies have described an explanatory relationship between rumination and executive control in connection with OGM. Previous research examining both rumination and executive control in the context of OGM suggests that working memory, a component of executive control, does not account for the relationship between rumination and OGM (Raes et al., 2006). Little, if any, research exists examining the connection between verbal fluency (the broad operationalization of executive control used in this study) and rumination in OGM.

However, outside of OGM research, various relationships between the brooding component of rumination and different aspects of executive control have been documented. Difficulties with both set-shifting and cognitive inhibition have been linked to brooding (Lo & Liu, 2017; Whitmer & Banich, 2007). This provides evidence that problems with changing mental set and blocking out irrelevant information – both functions of executive control – are related to rumination. Relationships between executive control and rumination, particularly brooding, have also been found in connection with induced stress. Deficits in executive control while coping with stress are

related to depression severity in high ruminators (Quinn & Joorman, 2014), while high ruminators also experience a decrease in salivary cortisol response during stress induction following training to increase executive control (Quinn, Keil, Utke, & Joorman, 2014). Thus, rumination level seems to influence an individual's ability to use their cognitive resources – executive control – during times of stress.

Clearly, there is a relationship between rumination and executive control outside of OGM research. This relationship may extend to the OGM phenomenon although few studies have examined such a relationship. It stands to reason, then, that rumination may have indirectly accounted for variance in OGM in the current study by directly accounting for variance in executive control.

Functional Avoidance (FA). The observed correlation between rumination and avoidant coping contradicts CaR-FA-X model theory and previous research, which posits that rumination is more tied to OGM experienced in the context of depression, while the FA mechanism gives rise to OGM following trauma-induced stress (Sumner, 2012). CaR-FA-X model theory does not suggest that rumination and FA would be related in any way, since they are connected to psychopathologies that have historically been considered distinct. However, in the current study, avoidant coping and rumination shared several characteristics in common. First, neither FA nor rumination exhibited a relationship with OGM, although such a relationship was expected. Second, both variables were correlated with MDD and PTSD symptomatology while OGM was not. Third, both variables were significantly correlated with each other.

The similarity in the relationships between rumination, FA, and the other variables coupled with rumination's unclassified contribution to the analysis suggests that rumination may mediate the relationship between FA and OGM. While no such connection has yet been established, CaR-FA-X model theory may support this interpretation. Previous evidence suggests that the FA mechanism acts as a "gate" against involuntary bottom-up retrieval of specific negative memories in PTSD caused by impaired executive control (Ono et al., 2015). FA acts as a gate by outputting negative general memories instead of negative specific memories (Williams, 2006). If this gating action were due to mnemonic interlock caused by rumination, this would explain the observed relationship between rumination and FA, and their similar relationships with the mental health variables and OGM.

Indeed, research examining rumination and cognitive avoidance supports this interpretation. Rumination has been shown to mediate the effect of cognitive avoidant coping on sadness and anxiety (Dickson, Ciesla, & Reilly, 2012) and is also related to the use of cognitive avoidance strategies following induced stress (McEvoy, Moulds, & Mahoney, 2013). Some models of PTSD actually describe rumination as a cognitive avoidance strategy that prevents productive processing of the traumatic event by instead causing repetitive focus on irrelevant negative information (Echeverri, Jaeger, Chen, Moore, & Zoellner, 2011). Taken together, this supports the interpretation that the lack of relationship between avoidant coping and autobiographical memory specificity may be due to rumination's lack of direct relationship with the criterion.

Impaired Executive Control (X). Of the three CaR-FA-X model mechanisms, only executive control exhibited the expected relationship with OGM, in that it was both correlated with autobiographical memory specificity, and uniquely explained variance in OGM. Further, the lack of correlation with MDD and PTSD symptomatology suggests that the impaired executive control mechanism operates independently of the two disorders, and is instead a direct mechanism contributing to the phenomenon of reduced autobiographical memory specificity observed in these disorders. This is consistent with previous research on the relationship between executive control and OGM (Ellis & Ashbrook, 1988; Hertel & Hardin, 1990; Neshat-Doost et al., 2008; Ridout et al., 2016; Sumner et al., 2011).

Although alternate interpretations of the CaR and FA mechanism's lack of relationship to OGM are offered above, it is also possible that impaired executive control is the only CaR-FA-X model mechanism directly at play in OGM. Indeed, if rumination does contribute to OGM by accounting for changes in executive control and mediating the relationship between functional avoidance and OGM, it would follow that impaired executive control would be the only one of the three mechanisms to directly impact OGM. This interpretation contradicts previous research linking rumination and FA to OGM, although much of this research has not examined the interrelationships between the CaR-FA-X model variables, and thus may not fully account for the nature of these mechanisms' connection to OGM (Sumner, 2012). Another possible explanation is that the 30-second time limit imposed upon participants' typed responses to each AMT probe word may have resulted in a high degree of pressure to respond quickly, particularly for

those with a lower baseline level of executive control. Thirty-second response time limits are commonly used in orally administered AMT formats (e.g., Sumner et al., 2011); typed-response, computerized versions of the AMT have also been shown to replicate the OGM phenomenon (e.g., Rekart et al., 2006). However, the combination of these two features (i.e., 30-second response time limit x typed-response format) may have resulted in increased response pressure in individuals with lower executive control, thus leading to a decrease in demonstrated autobiographical memory specificity in those individuals. Since executive control plays a role in response time, the time pressure may have produced AMT responses that only varied based on executive control. Put another way, this time pressure may have prevented the relationship between OGM and the other two mechanisms (i.e., CaR and FA) from being detected. This explanation is partially supported by the finding that participants in a non-clinical sample demonstrate OGM following executive control depletion via the Stroop colour word task (Neshat-Doost et al., 2008). The time pressure, however, represents an acute stressor and may mimic a frustration induction. If it were the case that stress related to the time pressure played a key role in determining the observed relationships to OGM, it is expected that a relationship between OGM and FA would also have emerged, as this relationship has been demonstrated in non-clinical samples following an acute stress induction (Debeer, et al., 2012).

It is also possible that, given the diversity of the sample, there may have been an unusually high number of "English as a second language" (ESL) students represented. This would also explain the singular explanatory relationship between executive control

and autobiographical memory specificity, including the lack of relationship between autobiographical memory specificity and the other two CaR-FA-X model mechanisms (rumination and functional avoidance). Since both the AMT and COWAT (measures of autobiographical memory specificity and executive control) were timed, and thus required a high level of English fluency to generate rapid responses, it is possible that English language learners may have had a difficult time on both tasks. This difficulty may have exacerbated the relationship between autobiographical memory specificity and executive control, possibly overshadowing or confounding the other two mechanisms' relationships to OGM. However, it is not possible to determine whether English fluency impacted the study results, as data regarding participants' native language and English fluency was not collected.

Further, the majority of OGM research has been conducted in Western countries (i.e., the United Kingdom, the Netherlands, Germany, etc.). Although a few studies have replicated the OGM phenomenon in non-western countries (e.g., in Iranian suicide attempters [Kaviani, Rahimi-Darabad, & Naghavi, 2005], in Chinese middle school children with PTSD [Chen, Huang, Dang, & Zheng, 2012], in bereaved Afghan adolescents [Neshat-Doost, Yule, Kalantari, Rezvani, Dyregrov, & Jobson, 2014]), the construct has not been extensively substantiated as a cross-cultural phenomenon. Specifically, little research has been done in collectivistic Asian cultures, such as China and Japan. Although OGM has been detected in one Chinese sample, it is possible that OGM may be a phenomenon that is primarily observed in Western countries, where the emphasis is more on individual experience. It is possible that personal experience and

specificity in individual autobiographical memory may be less emphasized, and thus personal experience may be less likely to be reported specifically in Asian cultures. If OGM is a primarily Western phenomenon, then the sample's diversity may partially explain the lack of observed relationship between the rumination and FA mechanisms and OGM.

CaR-FA-X Model Interactions

As previously discussed, the two- and three-way CaR-FA-X model interaction terms did not have a significant incremental effect on autobiographical memory specificity above and beyond the individual CaR-FA-X model mechanisms, despite significant correlations with OGM among the interaction terms containing executive control. Since the CaR-FA-X model mechanisms have rarely been studied in conjunction with one another, this provides interesting insight into the relationships between the mechanisms.

The incremental effect of the CaR-FA-X model interaction terms over and above that of the individual CaR-FA-X model mechanisms approached significance at the trend level, thus suggesting that an effect might have been observed with a larger sample size, or under different circumstances (i.e., when direct relationships between rumination, FA, and OGM are observed). However, it is also possible that all three mechanisms do not combine to produce an effect on OGM greater than the sum of all three mechanisms. At face value, the current study provides evidence that the CaR-FA-X model mechanisms operate independently of one another. The CaR-FA-X model mechanisms do not appear to multiply the effects of one another.

Cognitive Attributional Style

The cognitive attributional style variables also did not have a significant incremental effect on autobiographical memory specificity over and above that of the individual CaR-FA-X model mechanisms and the interaction terms. All three cognitive attributional style dimensions were significantly related to MDD symptomatology, reflecting the well-documented connection between attributional style and MDD observed in the literature (e.g., Abramson et al., 1978; Moore et al., 2017; Ruegers & George, 2017). Stability and globality were also related to PTSD symptomatology and rumination. Internality and globality were also correlated with FA. These connections are unsurprising, given that many of the variables that were related to cognitive attributional style are interrelated themselves.

The cognitive attributional style dimensions did not have a significant incremental effect on OGM over and above that of the CaR-FA-X model mechanisms, although taken together the dimensions did uniquely account for 2% of the variance observed in OGM. This speaks to some kind of relationship between memory encoding and OGM, even though that relationship was not statistically significant and was likely largely accounted for by the CaR-FA-X model mechanisms. The lack of significant incremental effect on OGM above and beyond the CaR-FA-X model mechanisms suggests then that cognitive attributional style may not be an adequate representation of memory encoding for the purposes of OGM research. Indeed, the cognitive attributional style dimensions may be more indicative of how the meaning ascribed to life events impacts our self-perceptions rather than how we encode and assign meaning to specific event memories. Further

research into the potential connection between OGM and other forms of memory encoding is necessary to determine whether memory encoding does, in fact, play a role in the OGM phenomenon.

Strengths and Limitations of the Current Study

The current study had a number of strengths, most notably that it examined the CaR-FA-X model mechanisms both individually and in conjunction with one another, which is rare among OGM studies. Further, the current study compared the CaR-FA-X model with a possible alternate explanation for the OGM phenomenon, which only served to strengthen support for the CaR-FA-X model. One limitation of the study, however, was that the sample used in the study consisted of undergraduate psychology students, and thus the results of this study may not extend to a clinical population, despite the relatively high average levels of MDD and PTSD symptomatology observed in the sample. Size of the sample may also have prevented the incremental effects of the CaR-FA-X model from being detected. The minimal instructions AMT may also have been too sensitive for the sample, and thus potentially detected OGM in individuals who would not have demonstrated the phenomenon if they had been administered the traditional AMT instead. This may have prevented relationships between the mental health variables and autobiographical memory specificity from being detected. Finally, since the study only examined one operationalization of encoding in conjunction with OGM, no conclusions regarding the potential impact of encoding on OGM could be drawn beyond determining cognitive attributional style's effectiveness as an encoding predictor.

Recommendations for Future Research

The current study found no correlation between OGM and several predictor variables that have previously evidenced strong relationships with the criterion (i.e., MDD symptomatology, PTSD symptomatology, rumination, and functional avoidance). Of the mental health and independent CaR-FA-X model variables, only rumination and executive control explained significant variance in autobiographical memory specificity. Of the two, only executive control contributed significant unique variance to the hierarchical linear regression model of OGM. The lack of relationship with the mental health symptomatology variables and rumination may be due to the use of an oversensitive measurement (the minimal instructions AMT) in an undergraduate sample with unexpected clinical characteristics. The lack of relationship with FA may be due to another CaR-FA-X model variable (possibly rumination) mediating the relationship between FA and OGM. Rumination may have contributed variance to OGM indirectly by explaining variation in executive control. It is possible, then, that differences in executive control observed in OGM research may be explained by rumination. Unexpected results may also be due to circumstantial stressors, measurement error, AMT administration format, or cultural factors.

Although three of the CaR-FA-X model interaction terms were significantly correlated with autobiographical memory specificity (i.e., CaR-FA-X, CaR-X, and FA-X), none of them contributed significant unique variance to OGM. Further, the CaR-FA-X model interaction terms did not have an incremental effect on OGM over and above that of the independent CaR-FA-X model variables. This suggests that the

CaR-FA-X model mechanisms operate independently of one another, or at the very least, that their effects do not compound to influence OGM. None of the cognitive attributional style variables (i.e., internality, stability, and globality) were significantly related to OGM, nor did they contribute significantly to the analysis. This suggests, at least, that cognitive attributional style is not an adequate operationalization of encoding for OGM research purposes.

The results of the current study suggest that future OGM research should focus on methodological issues such as evaluating the effectiveness of the minimal instructions AMT in clinical samples, as well as exploring various combinations of timed and typed AMT response formats. Future research should also examine on the effect of circumstantial stressors and English language learning status on AMT performance. Future CaR-FA-X model research should examine the nature of the relationship between rumination and the remaining two CaR-FA-X model mechanisms, as well as on further testing the CaR-FA-X model in non-Western cultures. Additional OGM research may also explore other potential memory encoding variables that might contribute to the OGM phenomenon.

Studies regarding the effectiveness of the minimal instructions AMT should examine the degree to which the instrument is successful in detecting differences in OGM in a clinical sample. The current study suggests that the minimal instructions version of the AMT may be too sensitive for use in clinical populations already prone to demonstrating high levels of OGM. Future research should determine whether the relationships between OGM and depressive symptoms and OGM and rumination disappear when the minimal

instructions AMT is used in a clinical sample versus a non-clinical sample. If so, this would reflect the pattern observed with the standard AMT when it is used in non-clinical samples. If it is substantiated that a floor effect typically results from using the minimal instructions version of the AMT in a clinical sample, this would help in establishing parameters for the optimum effectiveness of the minimal instructions AMT.

In examining methodological concerns in the AMT, it would be beneficial to further explore the effect of typed-response administrations on AMT performance. If the expected relationships between OGM and all three CaR-FA-X model mechanisms can be observed with a typed-response AMT, this would increase ease of administration and facilitate faster completion of OGM research on a larger scale. Comparison between typed-response and oral-response formats in terms of detected autobiographical memory specificity levels and ability to detect relationships between OGM and associated variables (i.e., depressive symptoms, PTSD symptoms, rumination, FA, and executive control) is necessary to determine the relative effectiveness of typed-response AMT formats. Although typed-response AMT administrations have replicated the relationship between depressive symptoms and OGM (e.g., Rekart et al., 2006), no known experimental comparison between typed and oral response formats exists. If successful, examination of the effect of timed versus untimed administration in a typed-response format AMT would help to establish guidelines for the possible use of a typed-response AMT in future OGM research, as no current protocol exists for administration of a typed-response AMT.

Additional methodological research should examine the effectiveness of the AMT at detecting OGM in English language learners. Since the AMT is typically administered in a timed format, with a time limit ranging from 30 to 60 seconds per response, it may be difficult for English language learners to formulate full, specific responses to each probe in the time allotted. Thus, using the AMT in an ESL sample may result in increased observed OGM. Comparison of autobiographical memory specificity levels observed in an English-fluent sample should be compared with those observed in an ESL sample to determine the limitations of standard AMT use with English language learners. It would also be interesting to compare standard timed AMT administration scores for English-fluent participants with untimed English AMT administration scores for ESL participants. If OGM levels in both samples are similar, an untimed AMT administration maybe an appropriate accommodation for ESL participants. Regardless, future studies using the AMT would benefit from including a simple ESL screening question (e.g., "Is English your first language?") with administration, in order to detect English language learning as a possible confounding variable.

Further research regarding OGM would benefit from examining the effect of circumstantial life stressors on AMT performance. Do individuals under relatively high degrees of life stress demonstrate more OGM than individuals under lower degrees of stress? The effect of experimental stress and frustration induction on AMT performance has been examined in previous OGM research (e.g., Debeer et al., 2012), however, little research has examined non-traumatic current life stressors in connection with OGM. If life stress level does impact AMT performance, controlling for life stress in future OGM

research may help to further isolate the effect of CaR-FA-X model mechanisms on OGM. Screening for current life stress, such as academic or political stressors, may help improve the quality of AMT data collected in future studies. For undergraduate samples in particular, it would be interesting to compare AMT performance at three distinct points in time: at the beginning of the semester, in the middle of the semester, and during finals. Such an investigation, combined with a measurement of experienced stress, would help illuminate the role of natural (i.e., non-experimental) stress in impacting OGM.

Future research on the connection between rumination and the other two CaR-FA-X model mechanisms should examine the nature of interrelationships among the three mechanisms, specifically focusing on a possible meditational relationship between rumination and FA, as well as a possible moderational relationship between rumination and executive control in connection with OGM. Research into whether rumination-induced mnemonic interlock plays a role in creating the FA gating mechanism would especially illuminate the nature of the relationship between these two mechanisms, while research into how specific components of executive control interact with rumination and its subcomponents would elucidate the connection between rumination and executive control. Continued examination of interactions among all three CaR-FA-X model mechanisms is also necessary.

Further research on OGM and the CaR-FA-X model should focus on replicating the OGM phenomenon in non-Western cultures, as well as on the effectiveness of the CaR-FA-X model in explaining any OGM observed in non-Western cultures. Although OGM has been demonstrated in suicidal, bereaved, and traumatized non-Western

samples, the phenomenon has not been replicated to the same degree in Eastern cultures as it has been in Western cultures. Further, few, if any, studies examining OGM in Eastern cultures have focused on testing the CaR-FA-X model. If OGM is repeatedly observed in non-Western samples, exploration of the CaR-FA-X model in these same non-Western samples is paramount to establishing the CaR-FA-X model as a pan-cultural account of the mechanisms underlying OGM.

Future research on the role of memory encoding in OGM should focus on finding other representations of memory encoding that may be related to autobiographical memory specificity, as well as the CaR-FA-X model mechanisms. Additional research on the relationship between the cognitive attributional style dimensions and the CaR-FA-X model mechanisms would help further determine whether an individual's interpretation of events influences the mechanisms by which OGM occurs, and thus help explain the correlational relationship with the rumination and functional mechanisms observed in the current study.

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