

**A narrative synthesis of the applicability of the CaR-FA-X model in child and
adolescent populations: A systematic review**

**Tracy Stewart, Simon Hunter, Sinead Rhodes
University of Strathclyde School of Psychological Sciences and Health**

Abstract

Background: The CaR-FA-X model (Williams et al., 2007) is the most prominent and comprehensive model of overgeneral autobiographical memory (OGM) and provides a framework for OGM. The model comprises of three mechanisms, capture and rumination, functional avoidance, and impaired executive control. These can independently, or in interaction, account for OGM. This systematic review aims to evaluate the existing research on the CaR-FA-X model, and trauma exposure studies specific to child and adolescent populations. **Methods:** The following databases were searched: 'PsychInfo', 'PsychArticles', 'PubMed', 'Web of Science', 'Medline', 'SCOPUS' and 'Embase' for English-language, peer-reviewed papers with samples $< M = 18$ years, published since 1986. To account for the possibility of grey literature, six online journal databases 'OpenGrey', 'ProQuest', 'Web of Science Conference Proceedings', 'Copac', 'The British Library' 'Zetoc' and the 'Centre for Autobiographical Memory Research Conference proceedings' were also searched. **Results:** Support was reported for capture errors and trauma exposure as well as interactive effects between rumination and executive control. Limited support was found for rumination, avoidance and impaired executive control in isolation. **Conclusions:** Partial support for the CaR-FA-X model was found for child and adolescent populations. Recommendations, refinements to the model, and plausible explanations for the mixed findings are discussed.

Keywords: Overgeneral autobiographical memory; Autobiographical memory specificity, CaR-FA-X model; Children and adolescents

Introduction

Autobiographical memory (AM) is a memory storage system responsible for past episodic memories and self-related semantic information (Conway & Pleydell-Pearce, 2000). Overgeneral autobiographical memory (OGM), sometimes referred to as reduced autobiographical memory specificity (rAMS¹) refers to the phenomenon of a tendency to retrieve AM's for past personal events in a generalised, non-specific way. A specific memory is defined as an event that occurred at a specific time and place (e.g. last Saturday night at the cinema). Instead, categorical memories are defined as categories of events (e.g. every Saturday night) and extended memories are defined as events that last over an extended time frame (e.g. my summer holiday in Florida). The phenomenon of OGM has been widely investigated since first observed in a sample of suicidal adults (Williams & Broadbent, 1986). Since then, OGM has been associated with major depressive disorder (MDD; Sumner, Griffith, & Mineka, 2010; Williams et al., 2007) and post-traumatic stress disorder (PTSD; Kleim & Ehlers, 2008; Sutherland & Bryant, 2008) in adults. OGM is also indicative of a stable characteristic in adults recovered from depression (Mackinger, Pachinger, Leibetseder, & Fartacek, 2000). Given the clinical significance of OGM, researchers have begun to focus attention towards greater understanding of the theoretical underpinnings of OGM. Initial theoretical models of OGM suggested that the retrieval process may be impaired if a child was exposed to trauma (Williams, 1996). It was suggested that traumatised children adopted an overgeneral memory style as a way to avoid negative affect that was associated with specific memories. That is, traumatised children could learn how to truncate a memory search at an intermediate (i.e. general level) description as a strategy to avoid any negative affect

¹ Across studies, the terms overgeneral memory and reduced memory specificity are used interchangeably. Given the nature of scoring on autobiographical memory tests, overgeneral or specific memories are typically analysed. OGM refers to memories that do not contain specific details (e.g., categorical and/or extended), and rAMS refers to memories with limited amount of specific detail. See Griffith et al. (2012) for a review on methodological issues with the measurement of OGM (and rAMS).

which may elicit from a specific memory. This is called functional avoidance. This theory formed the basis for the ‘functional avoidance’ mechanism of the CaR-FA-X model. Williams and colleagues now recognise that a number of other mechanisms such as capture and rumination and impaired executive control contribute to OGM and so they established the CaR-FA-X (Williams et al., 2007) model. This model was developed as a framework to enhance understanding of OGM in adults (Williams et al., 2007). The model (see Figure 1) proposes three mechanisms that can disrupt the retrieval processes, in isolation or in interaction with each other. These mechanisms are; *capture and rumination* (CaR), *functional avoidance* (FA) and *impaired executive control* (X).

[Insert Figure 1 here]

The CaR-FA-X model (Williams et al., 2007)

The CaR-FA-X model is based on the foundations of Conway and Pleydell-Pearce’s (2000) self-memory model. The self-memory model of AM (Conway & Pleydell-Pearce, 2000) posits that the search for a specific memory requires a hierarchical search through the autobiographical memory knowledge store which has three levels of memory representations. The highest, broadest level holds memories including prolonged time periods (e.g. my time at university), general memories for repeated or single events (e.g. driving home from work each day or my summer holiday in Spain), and event specific knowledge primarily consisting of a summary record of sensory-perceptual processing which occurred during the event (e.g. my birthday party last Saturday). A memory for an event can be recalled in two ways, 1) through a generative process or 2) by direct retrieval. Generative retrieval refers to top-down processing spreading down through the autobiographical memory knowledge base, activating broad, to general and then to event specific memories in the hierarchy. Direct retrieval occurs when an environmental cue activates an immediate event specific knowledge. The CaR-FA-X model is a framework for generative retrieval, which proposes that the generative search

through the hierarchy of AM's is disrupted early in the process due to one or more of the proposed mechanisms of the CaR-FA-X model, resulting in the retrieval of an overgeneral memory.

Capture and rumination

The capture and rumination mechanism of the CaR-FA-X model posits that capture errors can result from a disruption of the retrieval process if conceptual, abstract information activated at an early stage is self-relevant or related to self-representations. Conceptual processing based on self-representations is predominant in the early stages of retrieval (Conway, Singer, & Tagini, 2004; Williams et al., 2007) and subsequently the search for a memory passes across the knowledge base rather than down the hierarchy (Sumner, 2012). The search then becomes aborted, resulting in OGM. If continued attempts are terminated at this general stage, these 'intermediate descriptions' will become elaborated and future attempts will likely activate conceptual information, which activates other intermediate self-representations rather than specific memories. This process is referred to as mnemonic interlock (Williams et al., 2007). Such capture errors are particularly prevalent in people who are prone to have elaborate and highly activated self-representations, for instance those diagnosed with depression or individuals who have a tendency to ruminate (Sumner, 2012; Williams et al., 2007). Nolen-Hoeksema (1991) refers to rumination as the perpetual and persistent focus of attention towards negative thoughts, depressive affect and their consequences. Ruminative thinking can elaborate the conceptual, abstract information which is activated in the early search for a specific memory. This focus on general representations at this early stage of retrieval increases the probability of attention becoming captured, in turn the search becomes truncated subsequently resulting in OGM.

Although the CaR-FA-X model does not differentiate between the different aspects of rumination, there are differing functions of the subcomponents of rumination. As an adaptive

form of rumination, reflective pondering refers to a non-judgemental attentional focus on problem solving (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Reflective pondering has been associated with reductions in symptoms of depression (Arditte & Joormann, 2011), and coping in adolescence (Burwell & Shirk, 2007). Brooding rumination is a maladaptive form of rumination, which refers to a passive focus on negative and self-blaming thoughts (Treynor et al., 2003). Conversely, brooding rumination has shown associations with depressive disorders as well as sub-clinical symptoms of depression in adolescence (Burwell & Shirk, 2007; Gibb, Grassia, Stone, Uhrlass, & McGreary, 2012). In the adult literature, brooding (not reflection) has been shown to mediate the relationship between symptoms of depression and OGM (Debeer, Raes, & Hermans, 2009).

Capture errors can also result from a discrepancy between high and low discrepant cue words. Cue words on the autobiographical memory test (AMT, Williams & Broadbent, 1986) can bring about discrepancies between a person's current state and their desired state. When there is a state of self-discrepancy, there is a change in processing to more general conceptual way of processing information. This is done as a method to maintain self-coherence (Conway & Pleydell-Pearce, 2000). Thus, the person becomes captured at this early stage of retrieval, causing the search to become abandoned and an overgeneral memory is recalled (Williams et al., 2007). It has been suggested that this method as a way to resolve self-coherence between an individual's current and ideal state is particularly salient in individuals prone to rumination given that repetitive thought in rumination is thought to be driven partly by the discrepancy between intended goals and current state (see Watkins, 2008 for a review).

Functional avoidance

Functional avoidance, which refers to the ability to remain at a general level of retrieval as a way of affect control, is the second mechanism of the CaR-FA-X model. The

self-memory model (Conway & Pleydell-Pearce, 2000) posits that OGM results from the recollection of general descriptions as these descriptions result in less affect in comparison to the retrieval of specific memories. Williams et al. (2007) call this functional avoidance. The activation of specific emotional memories can result in numerous strategies using top-down control processes in an attempt to avoid emotional responses from these specific memories. Therefore remaining at a general level of retrieval can act as a strategy to avoid negative affect. Williams et al. (2007) suggests that this strategy to remain at a general level of retrieval can become negatively reinforced through the avoidance of negative affect that is associated with specific memories associated with traumatic events. Furthermore, Williams et al. (2007) posits that this type of memory retrieval can generalise to other types of memories, not only those associated with a specific trauma. For example, individuals who have experienced a form of trauma are more probable to retrieve an OGM, even to neutrally valenced events as they have likely discovered that the retrieval of specific memories result can result in negative consequences (e.g. negative affect). It has been proposed that functional avoidance can take time to develop (Williams et al., 2007) and in some individuals, such a strategy may be flexible or helpful in some situations but for others it can become inflexible, and a habitual response.

Impaired executive control

The third mechanism of the CaR-FA-X model is impaired executive control (sometimes referred to as cognitive control). Executive control is a broad term referring to the ability to flexibly and efficiently coordinate one or more executive functions and processes (Roberts, 1998; Shah & Miyake, 1999; Williams et al., 2007). Despite much debate around what specific cognitive processes are involved in executive control (Diamond et al., 2013; Miyake et al., 2000) there is a general agreement that executive control refers to a set of cognitive processes responsible for the planning, initiation and monitoring of complex goal

directed behaviour (Daggleish et al., 2007). The search for a specific memory relies on executive resources and deficits in executive control can hamper a search strategy at different levels of retrieval, resulting in OGM. For example, impairment in working memory capacity can reduce the ability to hold and update retrieved information in working memory, while impaired inhibitory processing may allow irrelevant autobiographical material to enter the search, in turn capturing attention and truncating the search (Conway & Pleydell-Pearce, 2000; Williams et al., 2007).

Multiple mechanisms

The Car-FA-X model (Williams et al., 2007) posits that the three mechanisms (capture and rumination, functional avoidance, and impairment in executive control) can work in isolation or in interaction to predict OGM. For example, impairments in executive control can hamper the search strategy and cause a person to become ‘captured’ at this early stage of retrieval. Furthermore, the ability to inhibit irrelevant information will be particularly difficult if a person has a tendency to ruminate. Trauma exposure may also result in OGM indirectly due to reduced executive control. Through the constant attempts to avoid negative affect (functional avoidance), this can reduce the amount of cognitive resources available for other tasks, such as the recall of specific memories. Therefore an overgeneral memory may result from reduced executive control rather than the trauma per se. It is evident that there is great overlap between mechanisms yet there is a great predominance within the literature to investigate only one mechanism of the CaR-FA-X model.

Research with predominately adult populations do tend to support the CaR-FA-X model (see Sumner, 2012) however it is still unclear whether the model can account for OGM in childhood and adolescence and whether the mechanisms of the CaR-FA-X model account for OGM differently in clinical and non-clinical youth populations. It is important for research not only to provide evidence for OGM in adulthood but also to examine the way in

which memory specificity, or overgenerality, develops and differs across age (see Valentino, 2011, for a developmental overview of OGM). For example, OGM has been reported among children who have experienced burns (Stokes, Dritschel, & Bekerian, 2004) but a lack of a relationship has been reported in adult burn victims (Willebrand et al., 2002). This suggests that developmentally, the timing of exposure to trauma (i.e. trauma in childhood vs. adulthood) or the event itself may be an important factor for OGM. It further highlights that drawing conclusions about the strength of evidence of OGM in children and adolescence based on adult populations may be misleading. Previous researchers have also highlighted this issue (Hitchcock, Nixon, & Weber, 2014a).

Gaining a greater understanding of the factors underlying OGM in childhood and adolescence is an important research objective. Despite advances in intervention research, rates of depression are increasing (Compton, Conway, Stinson, & Grant, 2006). It is estimated that approximately 20% of adolescents will experience a clinically significant depressive episode by the age of 18 years (Davey, Yucel, & Allen, 2008). Moreover, relapse rates are as high as 60-90% in some cases (Dunn & Goodyer, 2006). In adolescence, depressive episodes last longer, are thought to be more severe than in adulthood and result in increased hospitalisation and suicidal thoughts and behaviours (Korczak & Goldstein, 2009; Van Noordenetal et al., 2011). Given the high relevance and relapse rates, as well as severity of symptoms, it is clear that a greater understanding of vulnerability factors that give rise to depression may be beneficial in informing preventative interventions.

OGM is one such vulnerability factor for depression. OGM is prevalent in children and adolescents diagnosed with depression (Kuyken, Howell, & Dalgleish, 2006; Park, Goodyer, & Teasdale, 2002), young people experiencing symptoms of depression (Drummond, Dritschel, Astell, O'Carroll, & Dalgleish, 2006), and in those who have experienced trauma (Crane et al., 2014). Recent evidence suggests that OGM is predictive of

later depressive symptoms and MDD in adolescence, independent of age, IQ and current symptoms of depression (Rawal & Rice, 2012a) and, like adult populations, OGM has been found in adolescents recovered from depression (Kuyken & Dalgleish, 2011). This suggests that OGM is not only a by-product of depression but serves as a cognitive vulnerability marker for future symptoms of depression and depressive disorders in child and adolescent populations. To date, the CaR-FA-X model is the most prominent and comprehensive theory of OGM.

OGM measurement

Overgeneral memory has been examined by a multitude of measures within the literature. The gold standard measure is the AMT (Williams & Broadbent, 1986). On the original AMT, participants were presented with 10 cue words (positive and negative). Participants were given one minute to retrieve a specific autobiographical memory in response to each cue word and the responses were recorded. If a specific memory was not given, prompts were given (e.g. can you think of a specific time, one particular episode?). Specific memories were determined based on a memory for a specific date, day of the week or time of the day. The AMT today, as described by Williams et al. (2007) asks participants to recall an event that each cue word reminds them of. Participants are told that the events can be important or trivial, a recent event or from a long time ago. The event should be specific (e.g. an event that happened at a particular time and place which lasted less than a day), and examples of specific memories are given along with practice trials to confirm understanding of the task. The length of time given to respond varies from study to study but typically involves 30 or 60 seconds. Memories are typically coded as specific, or overgeneral (categorical and/or extended memories), with a category for semantic memories and omissions.

The AMT is operationalised differently across studies, with some slight variations as

to the number and cue words given, the way in which the cue is delivered, the time limit for responses, and how the measures are scored. For example, some authors opt for using the number of memories for the unit of analysis (Crane et al., 2014), while others opt for the proportion (Brennen et al., 2010). A recent review of the methodological issues in the measurement of AM concluded that for at least now, it is not clear which method of scoring (i.e. number vs. proportion) works best (Griffith et al., 2012). There is also great heterogeneity in the type of memory analysed, which has theoretical implications. Some researchers examine specific memories (Johnson, Greenhoot, Glisky, & McCloskey, 2005) and others will opt for analysing overgeneral memories (Kuyken, Howell, et al., 2006). Griffith et al. (2012) argues that the choice of memory type used in analysis has theoretical consequences. If specific memories are used as the memory type for analysis then effectively extended, categoric and semantic memories recalled are grouped together as overgeneral. Likewise, if overgeneral memories are used (e.g. categoric and/or extended), then semantic memories are grouped together with specific memories. To add further disparity, there is great debate as to whether omissions reflect an overgeneral memory or whether an individual recalled a specific memory but for whatever reason did not want to tell the examiner (see Griffith et al., 2012, for a review).

There are also written versions of the AMT in which participants are asked to write down their memories to the cue words (Raes, Verstraeten, Bijttebier, Vasey, & Dalgleish, 2010), a pre-school version (the AMT-PV; Nuttall et al., 2014), a constrained version which asks participants to recall memories for events 24 hours post trauma (Nixon, Ball, Sterk, Best, & Betty, 2013, study 1) and a minimal instruction version of the task (Debeer et al., 2009) to name a few. Research with adults has suggested that the original ATM (Williams & Broadbent, 1986) may not be sensitive enough to assess memory specificity in non-clinical samples (Debeer et al., 2009). The minimal instruction autobiographical memory test (Mi-

AMT; Debeer et al., 2009) omits asking participants for a specific memory and instead asks participants to recall a memory without stating it should be specific and no examples are given. The Mi-AMT has been shown to increase detection of reduced memory specificity in non-clinical populations (Debeer et al., 2009).

In addition to these variations on the AMT, there are a number of other measures that investigate OGM or rAMS such as structured interviews. The Autobiographical Memory Interview (AMI; Kopelman, Wilson, & Baddeley, 1989) is a two part interview that examines recall of semantic autobiographical information (e.g. personal facts) and specific episodic memories (e.g. specific events recalled from three time periods, childhood, early adult life, and recent events). No cue words are given and scoring derives from the amount of detail provided about the time and place of each event. AM has also been examined with the Family Disagreements Questionnaire (FDQ; Salzinger, Feldman, Hammer, & Rosario, 1992). For example, Orbach, Lamb, Sternberg, Williams, and Dawud-Noursi, (2001) utilised the FDQ to assess autobiographical memory style. The FDQ asks children about child-parent and interparental disagreements and Orbach et al. (2001) coded the types of response utterances as specific utterances, generic/categoric utterances, generic/extended utterances and omissions. If a non-specific memory was given, children were prompted for a specific memory. The proportion of generic/categoric was used in the analysis.

It is not clear within the literature as to which task or scoring method works best but given that OGM has been reported across variations in task design and scoring, this suggests that OGM is a robust phenomenon. While the measurement issues surrounding OGM in children and adolescents is not the main focus of the current review, information on AM measures within the included studies is included. Given the different variations of OGM measurement included in the current review, and the theoretical and practical issues

discussed, a separate review of AM measurement specifically in child and adolescent populations would add a significant contribution to the **literature**.

Previous vs. current review

Previous reviews on OGM primarily focus on studies which include few child and adolescent populations (Sumner, 2012; Williams et al., 2007). Drawing conclusions about the strength of evidence of the applicability of the CaR-FA-X model in children and adolescence based on adult populations may be misleading. However, two reviews with child and adolescent populations have been published, though each has certain limitations. Valentino (2011) focused on developmental aspects of memory specificity, rather than specifically reviewing the CaR-FA-X model. Hitchcock, Nixon, and Weber (2014a) investigated OGM in child psychopathology, with a sub-section (8 studies) on the applicability of the CaR-FA-X model and ten studies separately investigating trauma exposure and OGM. More evidence is now available. The current review investigates 26 studies, 19 of which provide findings for one or more of the mechanisms of the CaR-FA-X model directly and 17 on the effect of trauma exposure on OGM (some studies provide findings for trauma exposure and the CaR-FA-X mechanisms, e.g. Hitchcock et al. 2014b). Given the importance of trauma exposure on OGM (i.e. Williams, 1996), and like previous reviews, we will also consider the effect of trauma exposure on OGM. These studies will be evaluated separately to the CaR-FA-X model. This evidence can allow a more nuanced, complex understanding of OGM in young people. For example, we can now review literature which investigates the interacting mechanisms of the CaR-FA-X model and examine any differences between clinical and non-clinical child and adolescent populations.

There is great heterogeneity of the included studies in relation to AM measurement including the unit of measurement, number and volume of cue words, cue presentation and measurement type (specific vs. OGM). The studies reviewed further vary in their scoring

algorithms, with some authors analysing the number or proportion of OGM or specific memories, with some opting to analyse omissions as an OGM, while others exclude them. It is been argued that effect sizes from different studies cannot be compared if they are calculated differently (see Griffith et al., 2012; van Vreeswijk & de Wilde, 2004). Given the heterogeneity of the included studies in the current review, we do not provide a meta-analytical synthesis but instead provide a narrative synthesis of the literature.

Aims and objectives

This review aims to systematically evaluate the three mechanisms of the CaR-FA-X model by assessing studies that have examined one or more of the mechanisms in child and adolescent, clinical and nonclinical populations. We add nuance to the most recent review in this area by including research studies from the ‘grey literature’, defined by Lefebvre, Manheimer, and Glanville (2008) as “literature that is not formally published in sources such as books or journal articles” (p. 106), longitudinal studies and studies investigating the interacting effects of the CaR-FA-X model. Previous reviews with child and adolescent populations (i.e. Hitchcock et al., 2014a) did not include grey literature. We are also the first review of the CaR-FA-X model specific to child and adolescent populations that includes previous research which investigated the interacting effects between mechanisms of the CaR-FA-X model. Across 26 studies, we examine 10 findings for the CaR mechanism (five capture, nine rumination), three for the FA mechanism and 13 findings for the executive control mechanism. Seventeen findings on the relationship between trauma exposure and OGM are included. In this way, the review will provide a greater understanding of the associations and vulnerability to OGM, across different populations (e.g., clinical vs. non-clinical), while accounting for measurement differences and symptoms of depression.

Methodology

Summary of search strategy

Literature search strategies were developed using medical subject headings (MeSH) and text words related to autobiographical memory in childhood and adolescence. Seven online journal databases 'PsychInfo', 'PsychArticles', 'PubMed', 'Web of Science', 'Medline', 'SCOPUS' and 'Embase' were searched for English-language, peer-reviewed papers, published since Williams and Broadbent's (1986) seminal paper, which investigated, or commented upon, the relationship between one or more of the functions of the CaR-FA-X model and autobiographical memory in childhood or adolescence (mean age <18 years old). We considered studies with some participants above the age of 18 years only when the mean age of the whole sample was 18 years or less. The key words employed included: ('autobiographical memory' OR 'episodic memory' OR 'retrospective memory') AND ('specific' OR 'overgeneral' OR 'over general' OR 'over-general' OR 'categoric' OR 'extended') AND ('child' OR 'adolescent' OR 'youth' OR 'minor' OR 'girl' OR 'boy' OR 'teen'). The last date searched was January 2016. To account for the possibility of grey literature, six online databases 'OpenGrey', 'ProQuest', 'Web of Science Conference Proceedings', 'Copac', 'The British Library' 'Zetoc' and the 'Centre for Autobiographical Memory Research Conference proceedings' were also searched. Requests were made to authors of the 26 included studies (71% response rate) for any possible unpublished data and reference lists of included studies were also examined for any additional relevant studies. The results of the search are summarised in Figure 2.

[Insert Figure 2]

Selection, inclusion and exclusion

At stage 1, the initial search returned a total of 3317 results (see Figure 2). We identified 1975 results from peer reviewed journals and a further 1342 results from a grey

literature database search. From the original search results, 21% were duplicates and thus removed. Titles and abstracts were screened at stage 2 (n = 2596). Inclusion criteria was that studies were retained that examined one or more of the mechanisms of the CaR-FA-X model in children or adolescents (mean age < 18 years old) were retained. Studies were also retained if they investigated one or more of the mechanisms but did not specify the CaR-FA-X model. For example, a paper investigating the effects of trauma on overgeneral memory was retained, even though it did not refer to the model. Clinical and non-clinical samples were included. A sub-sample of 10% of titles and abstracts were independently reviewed by one reviewer at stage 2 (97% agreement). Any discrepancies were resolved through discussion. A majority of these studies (n = 2543) were removed from further analysis as they did not meet criteria. At stage 3, a total of 53 studies (46 peer-reviewed studies and seven from the grey literature) full-text articles were assessed for eligibility (based on the inclusion criteria discussed above). The papers were read in their entirety and scrutinised for relevance. A sub-sample of 10% of full-text papers were independently reviewed by one reviewer at stage 3 (100% agreement). In total, 30 papers were removed from the analysis and the justification for this removal is detailed in Figure 2. Twenty three articles (peer-reviewed, n = 22, grey literature, n = 1) were identified through this search strategy and deemed eligible for inclusion in the review. Three further studies were located and included. One study was located in reference list checks, one unpublished study was cited in a peer-reviewed paper and one unpublished study was included from the review authors. Requests from included study authors for unpublished work unveiled one unpublished manuscript (already located through the grey literature). The total number of studies in the current review was 26, of which 23 were peer-reviewed studies and 3 were unpublished studies.

Data extraction and quality assessment

Retained studies were reviewed and relevant data was extracted using an adapted

version of data extraction forms based on information from the Cochrane Handbook (Higgins & Green, 2011, see Appendix 1). To ensure consistency across reviewers, a calibration exercise was conducted whereby two reviewers independently screened 10% of papers with the data extraction from and guidelines (93% agreement). Data abstracted included study eligibility, population and setting details, participants and method details, and all reported results and outcomes. Any conflicts were resolved through a subsequent team discussion. To reduce potential errors on data extraction we extracted information as reported, any modification to data was done after extraction (e.g. changing % male to number of males).

An adapted version of the Newcastle-Ottawa scale (NOS) was used to assess of the quality of studies (see Appendix 2). The Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011) suggests that the items on the NOS may still need to be customized to the review question of interest. Modified versions of the NOS scale have been used by several other researchers to appropriately assess the quality of cross-sectional studies (Herzog et al., 2013; Patra et al., 2015). The NOS has demonstrated content validity and inter-rater reliability (Wells et al., 2015). A maximum of nine points can be awarded on quality assessment for cohort and case control studies. A search of the literature highlighted a score of seven or more as a cut off to be considered a good quality study (see McPheeters et al. 2012; Patra et al., 2015). A maximum of seven points can be awarded on quality assessment on cross-sectional studies and therefore a score of five or above is considered a good quality study. Due to the heterogeneous nature of the included studies, individual studies were not quality assessed against each other but instead a quality score is provided for descriptive purposes only. Quality assessments were undertaken by the first author and 10% and were screened by an additional reviewer (92% agreement). Conflicts were resolved through a subsequent team discussion.

Reporting

To ensure appropriate reporting and transparency throughout, the Preferred Reporting Items for Systematic reviews and Meta Analyses (PRISMA) statement and guidelines were used to guide the current review (Liberati et al., 2009). An updated version became available during the review (Shamseer et al., 2015) and the review met these guidelines.

Data analysis

The studies identified varied substantially in terms of their study design, tasks used, and scoring procedures applied to outcome measures. Therefore, the summary of data was carried out using narrative synthesis. To ensure a robust and transparent synthesis of the evidence, the narrative synthesis explored the relationship and findings both within and between the included studies, in line with the guidance from the Economic and Social Research Council (ESRC) Methods Programme (Popay et al., 2006). The guidance offers four elements along with several tools and techniques that can be applied to the synthesis process. These elements include: developing a theory, developing a preliminary synthesis, exploring relationships within and between studies, and assessing the robustness of the synthesis (see Figure 3).

[Inset Figure 3]

Results

Description of studies included

Twenty six studies were included in the review (three unpublished). Of the 23 peer-reviewed studies, the median number of participants per study was 89 (range 24 – 5792). The age of the participants was 4 to 20 years with a median age of 14.35 years. Twenty two of the peer reviewed studies provided gender information and 43% of the participants were male. Fifteen studies examined one mechanism of the CaR-FA-X model in isolation, five examined two mechanisms and no published study examined all three mechanisms of the CaR-FA-X

model. Sixteen published studies investigated trauma exposure. Of the three unpublished studies, the median number of participants per study was 196 (range 149 – 246). The age of the participants ranged from 12 to 17 years (age range not available for one study) with a median age of 14.18 years. All three studies provided gender information, 41% were male. One study examined one mechanism of the CaR-FA-X model in isolation, one examined two mechanisms and one examined all three mechanisms. One study investigated trauma exposure.

Across all 26 included studies, 16 examined one mechanism in isolation, six examined two mechanisms and one examined all three mechanisms of the CaR-FA-X model. Overall, seventeen of the studies investigated the effect of trauma exposure on OGM. Quality assessment was conducted on 25 studies (see Table 1), and grouped into three categories: cohort, case-control and cross-sectional. Due to a lack of information, one study was not quality assessed (Smets et al., N.d as cited in Smets et al., 2013) but remained included. Eight were cohort studies (two unpublished), ten studies were case control and the remaining eight were cross-sectional (one unpublished).

[Insert Table 1]

Clinical status and participant selection

Of the 26 published studies, six studies reported a sample with a clinically diagnosed mental health disorder. Two of these studies included diagnosis of depression (Kuyken et al., 2006; Park, Goodyer, & Teasdale, 2004), one sample with clinical PTSD (Nixon, Ball, Sterk, Best, & Betty, 2013, study 2) and three studies employed a sample with a diverse range of clinical disorders, including borderline personality disorder, anorexia nervosa conduct disorder, PTSD and mood disorders (Arie, Apter, Orbach, Yefet, & Zalzman, 2008; de Decker, Hermans, Raes, & Eelen, 2003; Valentino, Bridgett, Hayden, & Nuttall, 2012).

Of the remaining non-clinical studies, six included school community samples

(Brennen et al., 2010; Neshat Doost et al., 2014; Raes et al., 2010; Schoofs, Hermans, & Raes, 2012, study 1 & 2; Smets, Griffith, Wessel, Walschaerts, & Raes, 2013). None of Brennen et al.'s (2010) sample had a current of previous clinical diagnosis, and Schoofs et al. (2012), study 1 and 2 removed participants who met criteria for a current major depressive episode. Neshat Doost et al., 2014, Raes et al. (2010) and Smets et al. (2013) gave no reference to previous or current clinical psychopathology in their samples. All of the studies measured self-reported symptoms of depression. Four studies were derived from ongoing larger studies (Crane et al., 2014; Johnson, Greenhoot, Glisky, & McCloskey, 2005; Orbach et al., 2001; Rawal & Rice, 2012b). Crane et al.'s (2014) sample was assessed for probable cases of depression (based on questions given to mothers, and responses assessed by clinical psychologists), and noted findings including and excluding participants with probable depression. While clinical depression was not examined in Johnson et al.'s study, they reported that almost one third of their sample scored above clinical cut-off for depression (as measured via self-report). Orbach et al. (2001) gave no reference to previous or current clinical psychopathology in their sample but they did measure self-reported symptoms of depression. Rawal and Rice (2012b) recruited non-clinical adolescents (screened for past or current depression, dysthymia and depression not otherwise specified), though their sample was at familial risk to depression.

Two studies recruited participants from hospitals (Hitchcock, Nixon, & Weber, 2014b; Nixon et al., 2013, study 1), two from a range of community sources (Nuttall, Valentino, Comas, McNeill, & Stey, 2014; Stokes et al., 2004) and the remaining three studies recruited participants from either a child maltreatment diagnostic and treatment centre (Ogle et al., 2013), participants referred to local Department of Human Services (DHS) because due to concern of child maltreatment (Valentino, Toth, & Cicchetti, 2009) and participants living in youth care (Meesters, Merckelbach, Muris, & Wessel, 2000).Hitchcock et al.'s (2014b)

participant sample, although exposed to trauma, had no previous diagnosis of depression, PTSD, or anxiety. Their sample was not receiving psychological treatment or taking psychotropic medication at the time of testing. Hitchcock et al. (2014b) noted that 24% of their sample however reached clinical cut off for self-reported PTSD symptoms and 6% reached clinical cut off for self-reported symptoms of depression. Based on a self-reported PTSD symptoms, 11 children in Nixon et al.'s (2013, study 1) displayed high acute stress symptoms. All participant groups had low to mild scores of the Child Depression Inventory (CDI; Kovacs, 1992). Nixon et al. (2013, study 1) measured PTSD at time 2 via the Clinician Administered PTSD Scale for Children (CAPS-CA; Nader et al., 1998) and a structured clinical interview, however as the authors were investigating the effect of memory specificity on PTSD at follow-up and therefore did not meet the criteria for the current review.

Nuttall et al.'s (2014) sample included typically developing pre-school children. No reference to previous or current clinical psychopathology was provided given the age of the sample. Current or previous clinical diagnosis was not provided by Stokes et al. (2004). However, the authors noted one participant scored above the clinical cut off for self-reported depression, six for self-reported anxiety and four for self-reported PTSD (although there were no group differences on these measures). Ogle et al. (2013) stated that their participant sample was free from serious disorders, which included (but is not exclusive of) mental retardation, schizophrenia, or autism (based on self-reported medical and psychiatric diagnoses, clinical records and measures included in their study). The authors did not provide specific details on diagnoses that were excluded. Valentino et al. (2009) and Meesters et al. (2000) did not provide information on current or previous clinical psychopathology but Valentino et al. (2009) noted that self-reported symptoms of depression were within the sub-clinical range.

All three unpublished studies included community adolescents from a range of

secondary schools (Hitchcock, Nixon & Weber, N.d; Smets et al., N.d cited in Smets et al., 2013; Stewart, Hunter, & Rhodes, N.d). Current or previous clinical diagnosis was not reported in either Hitchcock et al.'s (N.d) or Stewart et al.'s (N.d) studies. Although Hitchcock et al. (N.d) reported that 25% of their sample reached clinical cut for self-reported PTSD. It is currently unknown whether Smets et al. (N.d cited in Smets et al., 2013) recorded past or current clinical diagnosis as this information was not included in Smets et al. (2013).

Outcome measurement

Outcome measures and variations in measurement task and scoring can be found in Table 2. .

[*Inset Table 2*]

Results have been summarised according to four broad categories: 1) capture and rumination, 2) functional avoidance, 3) impaired executive control and 4) interactions between mechanisms. We further include a section on trauma exposure. Within each category, a) the role of symptoms of depression, b) clinical status of the participants, c) methodology, d) outcome measures and e) whether the findings constitute a vulnerability to OGM was considered. A summary of findings for the 19 included studies investigating the CaR-FA-X model is presented in Table 3 and a summary of findings for 17 studies investigating trauma exposure on OGM is presented in Table 4.

[*Inset Table 3*]

[*Inset Table 4*]

Capture and rumination mechanism

Ten studies in total investigated the capture and rumination mechanism (three unpublished). Of the seven peer-reviewed studies, the number of participants tested was 858 and the median number of participants per study was 123 (range 49 – 230). The age of the participants ranged from 7 to 20 years with a median age of 13.70 years. All seven studies

provided gender information and 46% of the participants were male. Of the seven studies, one examined the capture aspect without rumination (Valentino et al., 2009), three examined rumination without the capture aspect (Hitchcock et al., 2014b; Park et al., 2004; Rawal & Rice, 2012b) and three studies investigated both capture and rumination (Schoofs et al., 2012, study 1 & 2; Smets et al., 2013). Capture was assessed by various methods including the use of high and low discrepant cue words (Schoofs et al., 2012, study 1 & 2), a self-discrepancy induction (Smets et al., 2013) and by examining negative self-representations (Valentino et al., 2009). Rumination was assessed by the ruminative response scale (RRS; Treynor et al., 2003) in three studies (Schoofs et al., 2012, study 1 & 2; Smets et al., 2013), the children's response styles questionnaire (CRSQ; Abela, Vanderbilt, & Rochon, 2004) in one study (Rawal & Rice, 2012b) and the children's response style scale (Ziegert & Kistner, 2002) in another (Hitchcock et al., 2014b). Only two of the published studies examined rumination by its subcomponents of brooding rumination and reflective pondering (Schoofs et al., 2012, study 1 & 2).

All three unpublished studies investigated the CaR mechanism. One study investigated the capture phenomenon (Smets et al., N.d as cited in Smets et al., 2013) and two studies investigated rumination (Hitchcock et al., N.d; Stewart et al., N.d). The number of participants tested was 591 and the median number of participants per study was 196 (range 149-246). The age of the participants ranged from 12 to 17 years (one study did not provide this information) with a median age of 14.18 years across the three studies. All three studies provided gender information and 41% of the participants were male. Capture was assessed by the use of high discrepant cue words. Rumination was assessed by the ruminative response scale (RRS; Treynor et al., 2003) in one study (Stewart et al., N.d) and the Children's Response Style Scale (CRSS; Ziegert & Kistner, 2002) in one study (Hitchcock et al., N.d). One of the unpublished studies examined rumination by its subcomponents of brooding

rumination and reflective pondering (Stewart et al., N.d).

The capture aspect was supported in three of the five (one unpublished) studies (Schoofs et al., 2012, study 1 & 2; Valentino et al., 2009). Schoofs et al. (2012, study 1 & 2) examined the capture aspect with non-clinical community adolescents. High and low discrepant cue words were used in the AMT (discrepancy between attributes of the actual and the ideal self) as a method of assessing the capture aspect. A greater proportion of categoric and a reduced proportion of specific memories were retrieved in response to high discrepant cues, in comparison to low discrepant words. Thus, when cues were not consistent with the adolescents' self-image this resulted in capture errors and reduced specificity and greater OGM. To account for the possibility that the findings were reflective of the importance of the cue to the adolescent, rather than the discrepancy per se, Schoofs et al.'s (2012) second study controlled for the effects of cue word importance and confirmed that the results could not be due to the importance of the cue to self-image. In a subsample of participants (abused and control adolescents), Valentino et al. (2009) found negative self-representations were related to OGM, providing support for the capture aspect of the capture and rumination mechanism of the CaR-FA-X model.

The rumination aspect was supported in one of eight (two unpublished) studies (Park et al., 2004). The authors examined OGM pre and post an experimental rumination and distraction manipulation task. In a sample of adolescents diagnosed with MDD, partially remitted MDD, a psychiatric control and a community control group it was found that rumination (but not distraction) increased OGM, but only within the MDD group (full and partially remitted). The increase in OGM due to rumination was specific to negative cue words and was independent of mood, age, gender or IQ.

Controlling for depressive symptoms

Of the four studies with significant effects (Park et al., 2004; Schoofs et al., 2012,

study 1 & 2), accounted for symptoms of depression and/or mood. Schoofs et al. (2012) entered depression scores as a covariate in their analyses and Park et al. (2004) reported that correlations between depression scores and changes in OGM with induced rumination were non-significant. Park et al.'s (2004) findings suggest that the increase in OGM in the MDD group was not due to changes in mood caused by the rumination induction. Valentino et al. (2009) did not control for symptoms of depression when investigating negative-self representations. Taken together, these findings suggest the capture and rumination mechanism contribution to OGM is not simply due to current symptoms of depression or mood.

Clinical status comparisons

Capture errors were reported in a community sample of adolescents who were not currently experiencing a major depressive episode (Schoofs et al., 2012, study 1 & 2) and a sample of adolescents with a history of abuse (Valentino et al., 2009). This suggests that capture errors are not simply a function of clinical disorder but are also found in samples with a trauma history and those who are not currently depressed. The only study to find an association between rumination and OGM comprised a clinically depressed sample (Park et al., 2004). This suggests that the association between rumination, in isolation, and memory specificity may be specific to clinical MDD. Future research is needed to verify this finding.

Vulnerability to OGM

To determine if the capture and rumination mechanism is an underlying vulnerability factor for OGM, longitudinal studies are needed. From the seven studies that investigated this mechanism in childhood and adolescence, four studies (2 unpublished) made use of such a design. No study found rumination, in isolation, to predict OGM over time. Two studies did however report interactive effects between rumination and other mechanisms of the CaR-FAX model (discussed later in the review).

Variations in tests of OGM

The unit of measurement, number and volume of cue words, cue presentation and measurement type (specific vs OGM) impacts on AMT performance (Griffith et al., 2012; van Vreeswijk & de Wilde, 2004). This varied across all studies (see Table 2) and may explain conflicting results. Smets et al. (2013) and Smets et al. (N.d as cited in Smets et al., 2013) are the only studies to report non-significant effects. The authors employed the Mi-AMT written version, similar to Schoofs et al. (2012), and therefore it is unlikely the null findings are due to the version of AMT. Smets et al. (2013) used a different scoring algorithm (number, not proportions), however they noted in their paper that the results did not alter when proportions were used instead of the number of memories, suggesting that the null findings are not due to the scoring of the AMT. As rumination was non-significant (with the exception of Park et al., 2004) across different versions of the AMT (original AMT, written AMT and Mi-AMT), it is unlikely that null findings of a relationship between rumination and OGM are due to the measurement of AM.

Functional avoidance mechanism

Three studies (one unpublished) directly investigated the functional avoidance mechanism of the CaR-FA-X model. Of the functional avoidance published studies, the number of participants tested was 86 (range 24-62). The age of the participants ranged from 11-18 years with a median age of 15.80 years. Male participants accounted for 14% of the sample. The one unpublished study (Hitchcock et al., N.d) can be found in Table 3. Of the functional avoidance studies, all three studies included a Criterion A stressor event required for the DSM–V for posttraumatic stress disorder (American Psychiatric Association, 2013). A Criterion A event is defined as exposure to actual or threatened death, serious injury, or sexual violence. This can include direct experience or witness to an event, learning about the event (e.g. occurred to family member or friend) or repeated or extreme exposure to aversive

details of events (e.g. police officers repeatedly exposed to details of child abuse). Trauma was operationalised as burn incidents requiring treatment at hospital (Stokes et al., 2004), trauma related to serious car accidents, physical assault, sexual abuse, being a witness to a death, accidents, and severe violence (Kuyken et al., 2006) and exposure to sexual or physical assault/abuse or war exposure (Hitchcock et al., N.d).

Avoidance was measured in three (one unpublished) studies (Hitchcock et al., N.d; Kuyken et al., 2006; Stokes et al., 2004) using the avoidance subscale of the impact event scale (Horowitz, Wilner, & Alvarez, 1979), the avoidance subscale of the children's Impact of Event Scale (Smith et al., 2003; Yule et al., 1994) and the Cognitive Avoidance Questionnaire (CAQ; Sexton & Dugas, 2008) scale. One of the three studies supported an association between avoidance and OGM (Stokes et al., 2004). The authors compared a group of adolescents who had been admitted to hospital due to a burn injury between the ages of 6 weeks and 14 years old with a control group of adolescents who had received orthodontic dental work. In the burn group, reduced specificity was correlated with higher avoidance, supporting the FA mechanism of the CaR-FA-X model. It should be noted however, that it is possible that reduced specificity could also be attributed to the exposure of the trauma disrupting normal autobiographical memory development, rather than functional avoidance per se. The literature is mixed on the relationship between functional avoidance and OGM. For example, Kuyken et al. (2006) found avoidance was associated with reduced levels of OGM (in a clinically depressed plus trauma exposed participant group), contradicting the CaR-FA-X model. Hitchcock et al (N.d) did not find any support for an association between avoidance and OGM in a community sample of adolescents. While Hitchcock et al. (N.d) noted that cognitive avoidance was greater in participants exposed to trauma, functional avoidance did not mediate the association between exposure to trauma and rAMS. As only three studies (one unpublished) have examined functional avoidance in children and

adolescents it would be erroneous to draw conclusions on the contribution of clinical status, design, vulnerability to OGM or AMT methodology. It is evident that more research is needed to directly test functional avoidance and its relationship with OGM.

Impaired executive control

Thirteen (two unpublished) of the included studies produced results for the impaired executive control mechanism of the CaR-FA-X model. Of the eleven published studies, the number of participants tested was 1075 and the median number of participants per study was 67 (range 27 – 230). The age of the participants ranged from 4 to 20 years with a median age of 13.38 years across the studies. Of the eleven studies, all provided information on gender. Male participants accounted for 47% of the sample. Of the two unpublished studies, the number of participants tested was 345 (range 149-196). The age of the participants ranged from 12 to 17 years with a mean age of 14.02 years across the two studies. Both studies provided gender information and 42% of the participants were male.

In the current review, inhibition was investigated in five studies (Hitchcock et al., 2014b; Hitchcock et al., N.d; Nuttall et al., 2014; Raes et al., 2010; Valentino et al., 2012), switching ability in one (Valentino et al., 2012), working memory capacity in six (de Decker et al., 2003; Hitchcock et al., 2014b; Johnson et al., 2005; Meesters et al., 2001; Nixon et al., 2013; study 1 & 2) and working memory monitoring and updating in one (Hitchcock et al., 2014b). Verbal fluency was investigated in three studies (Kuyken et al., 2006; Hitchcock et al., 2014b; Valentino et al., 2012) and executive control with more holistic measures of executive control was examined in two (Rawal & Rice, 2012b; Stewart et al., N.d).

Inhibition

Only one of the five studies that investigated links between inhibitory control and OGM reported a significant result (Raes et al., 2010). Employing the revised early adolescent temperament questionnaire (Ellis & Rothbart, 2001, as cited in Raes et al., 2010) to a sample of school children, Raes et al. (2010) found a relationship between greater OGM and reduced behavioural inhibition. Furthermore, Raes and colleagues indicated that reductions in inhibitory control partially mediated the link between symptoms of depression and OGM. This suggests that the link between depression and OGM, at least in part, is due to reduced inhibitory processing. Behavioural inhibition, however, as measured using the colour-word interference task and the day/night task were not associated with OGM (Nuttall et al., 2014; Valentino et al., 2012). Similarly, behavioural inhibition as measured by the “walk, don’t walk” subtest of the test of Everyday Attention for Children (Manly et al., 2001) was not associated with OGM (Hitchcock et al., 2014b; Hitchcock et al., N.d). While the CaR-FA-X model does not differentiate between types of inhibitory control, Williams et al. (2007) does suggest that the ability to navigate the search hierarchy requires the inhibition of other information within the memory hierarchy. This suggests that it is cognitive inhibition (the ability to inhibit prepotent mental representation including thoughts and memories) that is necessary for a successful search for a specific memory. This could explain the null findings reported with behavioural measures of inhibition, although this would not explain Raes et al.’s (2010) finding.

Working memory capacity

Of the six studies that investigated working memory capacity and OGM, only two demonstrated a link between working memory capacity and rAMS (Nixon et al., 2013; study 1) or OGM (Hitchcock et al., 2014b). Digit span scores (not errors) on the subtest of the Wechsler Intelligence Scale for Children — 4th Edition (Wechsler, 2003) were positively

associated with greater memory specificity (Nixon et al., 2013, study 1). Similarly, Hitchcock et al. (2014b) found that working memory capacity predicted OGM, although this effect was moderated by age. In older children, greater working memory capacity was associated with *less* OGM (as expected) whereas in younger children greater working memory capacity was associated with *greater* OGM recall (not expected). Although difficulty in working memory capacity was not associated with increased OGM (as proposed by the model), greater WMC was associated with greater memory specificity and less overgenerality. The finding that in younger children greater working memory capacity was associated with *greater* OGM recall refutes the impaired executive control mechanism of the CaR-FA-X model. Hitchcock et al. (2014b) further reported that high working memory capacity and high levels of inhibition resulted in greater OGM (contrary to the impaired executive control mechanism of the CaR-FA-X model).

Working memory updating

Only one study investigated the relationship between working memory updating and OGM but found no support for the mechanism (Hitchcock et al., 2014b). Employing a computerised n-back task in a trauma exposed sample of children, working memory updating was not found to be associated with OGM.

Verbal fluency

Verbal fluency was assessed in three studies (Hitchcock et al., 2014b; Kuyken et al., 2006; Valentino et al., 2012). Only one study found verbal fluency to be associated with OGM. Valentino et al. (2012) recruited 49 adolescent inpatients who were tested on measures of OGM, executive function and were grouped by the presence or absence of previous sexual or physical abuse (findings for trauma reported below). Across the whole sample, category fluency (closely related to switching), but not letter fluency, was significantly correlated with OGM. It should be noted that Valentino and colleagues refer to this fluency task as a measure

of updating and monitoring of information in working memory.

Switching

Switching ability was examined in one study. Valentino et al. (2012) employed the Wisconsin Card Sorting Test (WCST; Heaton, Chelune, Talley, & Kay, 1993) and reported no associations between switching ability and OGM in their psychiatric inpatient adolescent sample.

Holistic executive control

Two studies employed holistic measures of executive control. Rawal and Rice (2012b) employed the Block Design test of the Wechsler Intelligence Scale for Children (WISC-IV; Wechsler, 2004). While this is primarily a measure of visuo-constructional ability and performance, performance on this task taps working memory capacity and updating, as well as switching ability and the authors therefore employed it as a measure of executive control. The authors examined rAMS in a sample of adolescents at familial risk of depression. They found that impaired executive control was not independently associated with rAMS. Following on from this, Stewart et al. (N.d) examined executive control for emotional and non-emotional information employing the Internal Switch Task (De Lissnyder, Koster, Everaert, et al., 2012). The task, a general measure of executive control, involves the ability to inhibit and over-ride previous previously relevant information, and to switch between and update working memory. Stewart et al. (N.d) examined OGM in a community sample of adolescents, and executive control, in isolation, was not associated to OGM. Interestingly, both Rawal and Rice (2012b) and Stewart et al. (N.d) report interactions between executive control and other mechanisms of the CaR-FA-X model (reported below).

Controlling for depression

Of the four studies that reported associations between executive control and OGM only Valentino et al. (2012) controlled for depression in their analyses. Hitchcock et al.'s

(2014b) participants had no previous diagnoses of depression and, although three of their participant sample scored above clinical cut off on the CDI-S, the authors noted that symptoms of depression were not associated with OGM. Nixon et al. (2013, study 1) reported correlational effects of working memory capacity and rAMS but they did report that symptoms of depression were not correlated with memory specificity. Raes et al. (2010) did not control for symptoms of depression, and reported categoric memories were correlated with symptoms of depression. This suggests that the correlation between inhibition and OGM, in part, may be attributed to the effects from symptoms of depression. Indeed, mediational analyses show that in their sample, inhibitory control is important in the depression-OGM relationship as inhibition mediated the relationship between OGM and depressed mood.

Clinical status comparisons

Of the studies showing a relationship between OGM and executive control, one included a clinical sample (Valentino et al., 2012) and three included non-clinical samples (Hitchcock et al., 2014b; Nixon et al., 2013, study 1; Raes et al., 2010). Non-clinical status was as follows: two studies employed trauma exposed participants (Hitchcock et al., 2014; Nixon et al., 2013, study 1) and one study a community sample of children (Raes et al., 2010). The relationship between executive control and OGM was found in clinical, trauma exposed and community samples, suggesting that the relationship is not due to population differences.

Vulnerability to OGM

To determine whether impaired executive control is an underlying vulnerability factor for OGM, longitudinal studies are needed. From the 13 studies that investigated this mechanism in childhood and adolescence, six studies made use of such a design (Hitchcock et al., 2014b; Hitchcock et al., N.d; Johnson et al., 2005; Nixon et al., 2013, study 1; Rawal &

Rice, 2012b; Stewart et al., N.d). While Johnson et al. (2005) followed children over time, the authors only tested working memory capacity at the final testing session, providing cross-sectional data for this result. Similarly, Nixon et al. (2013, study 1) tested whether memory specificity predicted later symptoms of PTSD (not included in the current review) and did not test working memory capacity over time. Of the studies reporting significant effects, Hitchcock et al. (2014) was the only to find a relationship between working memory capacity and OGM over time. Although the authors reported that older children's greater working memory was associated with less OGM, there is a clear need for longitudinal studies to examine whether impairment in executive control underlies the development of overgeneral memory.

Variations in tests of OGM

All four studies which found an association between EC and OGM employed the AMT, although there were variations in task design across studies (see Table 2). Nixon et al. (2013, study 2) employed the same unit of measurement (number and volume of cue words, cue presentation) and measurement type as their first study (Nixon et al., 2013, study 1). These studies resulted in different findings which suggest the effects are not due to the outcome task design but instead attributed to other factors such as measurement of EC discussed above.

Interactions between mechanisms

Four (two unpublished) of the 26 studies have investigated interactions between the mechanisms of the CaR-FA-X model in child and adolescent populations (Hitchcock et al., 2014b; Hitchcock et al., N.d; Rawal & Rice, 2012b; Stewart et al., N.d). Two studies support interactions between mechanisms on OGM (Rawal & Rice, 2012b; Stewart et al., N.d), and two found no interactive effects between rumination and various aspects of executive control (working memory capacity, updating and inhibition) and no interactive effects between

trauma exposure, rumination and inhibition (Hitchcock et al., 2014b; Hitchcock et al., N.d). Rawal and Rice (2012b) assessed adolescents at familial risk of depression and reported that high levels of rumination, in the context of low executive control, predicted rAMS. In a follow up study with a community sample of adolescents, Stewart et al. (N.d) found that high levels of reflective pondering in the context of low executive control for emotional information predicted reduced OGM. This suggests that reflective pondering can act as a protective factor between low executive control and OGM, particularly when processing emotional information.

Controlling for depression and clinical status

Rawal and Rice (2012b) and Stewart et al. (N.d) controlled for symptoms of depression in their analyses suggesting that the effects reported are not due to depression symptoms.. Rawal and Rice (2012b) recruited non-clinical adolescents at familial risk of depression and two studies employed community adolescents recruited from a range of schools (Hitchcock et al., N.d; Stewart et al., N.d). Hitchcock et al. (2014b) recruited participants from hospital who had experienced a single accident trauma. Interestingly, while Rawal and Rice (2012b) found increased rumination to interact with low executive control to predict OGM, Stewart et al. (N.d) did not find brooding rumination (the maladaptive form) to interact with impaired executive control to predict OGM. In contrast, Stewart et al. (N.d) found that reflective pondering interacted with executive control to predict less OGM. There are two possible explanations for this finding. First, Rawal and Rice (2012b) did not examine rumination by its subcomponents and therefore it is possible that had they tested reflective pondering they may have found the same protective nature. However, it is also possible that the difference comes from the clinical status of the participants. While Rawal and Rice (2012b) assessed non-clinical adolescents, the sample had a parent with a history of depression. Previous research suggests that children with a depressed parent (whether

currently or previously), are less specific in their autobiographical memory recall in contrast to children of non-depressed parents (Woody, Burkhouse, & Gibb, 2015). Therefore, it could be argued that the interaction between high levels of rumination and low executive control is more pronounced on OGM in at risk samples.

Vulnerability to OGM

A limitation in the AM research, particularly in evaluating whether the mechanisms of the CaR-FA-X model are underlying vulnerability factors for OGM, is that the majority of studies are cross-sectional. Such studies cannot determine causality. While limited, each research study investigating interactive effects between mechanisms of the model on OGM with child and adolescent populations examine the relationships over time. Rawal and Rice (2012b) and Hitchcock et al. (2014b) investigated the impaired executive control mechanism and their interaction with other mechanisms on OGM over 6 and 12 months. Stewart et al. (N.d) had a follow up of 6 months and Hitchcock et al. (N.d) at the beginning and end of an academic year (estimated 10 months). Given that Stewart et al. (N.d) reported interactions after 6 months, in a community population, the follow up time is not suggested as a reason for null findings in other studies (Hitchcock et al., 2014b; Hitchcock et al., N.d). Although drawing conclusions from limited data is difficult, two studies do support interaction effects between executive control and rumination on OGM over time. These studies suggest that rumination in the context of executive control acts as underlying vulnerability for OGM.

Variations in tests of OGM

Only one study employed the minimal instruction version (Stewart et al., N.d) which, it has been argued, has greater sensitivity in detecting OGM in non-clinical populations (Debeer et al., 2009). This could explain the null findings (Hitchcock et al., N.d; Hitchcock et al., 2014b). Although Rawal and Rice (2012b) employed the traditional AMT, the task may have been sensitive enough to detect OGM in the at risk sample. Like most AM research, the

studies differed on the unit of measurement number and volume of cue words, cue presentation and measurement type (specific vs OGM). Stewart et al. (N.d) and Hitchcock et al. (2014b) however both reported effects for memory specificity and OGM, which did not affect original findings. This suggests that the type of memory as an outcome does not affect findings in the reviewed studies.

Trauma exposure

Seventeen (one unpublished) of the studies investigated trauma exposure on OGM. Of the published studies, the number of participants tested was 6857 and the median number of participants per study was 65 (range 24 – 5792). The age of the participants ranged from six to 20 years with a median age of 14.10 years across the sixteen studies. Of the sixteen studies, fifteen provided information on gender. Male participants accounted for 45% of the sample. The one unpublished study investigated trauma exposure and can be found in Table 4 (Hitchcock et al., N.d). Of the seventeen studies, all except one (Arie et al., 2008) included a Criterion A stressor event required for the DSM–V for posttraumatic stress disorder (American Psychiatric Association, 2013). A Criterion A event is defined as exposure to actual or threatened death, serious injury, or sexual violence. This can include direct experience or witness to an event, learning about the event (e.g. occurred to family member or friend) or repeated or extreme exposure to aversive details of events (e.g. police officers repeatedly exposed to details of child abuse). Trauma was operationalised as war exposure (Brennen et al., 2010), paternal death (10 + years ago) related to war (Neshat Doost et al., 2014), childhood sexual abuse (Ogle et al., 2013), physical and sexual abuse (Johnson et al., 2005; Valentino et al., 2012), witnessed and/or actual family violence (Orbach et al., 2001), burn incidents requiring treatment at hospital (Stokes et al., 2004), neglect, physical and sexual abuse (Meesters et al., 2000; Valentino et al., 2009), a single incident accidental injury which met conditions for a Criterion A event (Nixon et al., 2013, study 1) and participants

receiving therapy for trauma (Nixon et al., 2013, study 2). Hitchcock et al. (2014b) recruited children who had experienced a single incident accidental injury requiring medical treatment at hospital with the exclusion of physical or sexual abuse and loss of consciousness or brain injury due to trauma, while measuring trauma exposure for adverse life events. Three studies measured various events including but not exclusive of emotional neglect and abuse, physical abuse and sexual approach and abuse (de Decker et al., 2003), trauma related to serious car accidents, physical assault, sexual abuse, being a witness to a death, accidents, and severe violence (Kuyken et al., 2006) and death of a family member, physical or sexual abuse, and the removal of a child from home such as being taken into the care system (Crane et al., 2014). Hitchcock et al.'s (N.d) sample was exposed to sexual or physical assault/abuse or war exposure (exposed group vs. non-exposed group). One study investigated the effects of life events including events at school, parents, family and health (Arie et al., 2008).

Trauma exposure was associated with OGM or rAMS in 10 studies (Arie et al., 2008; Brennen et al., 2010; Crane et al., 2014; Neshat Doost et al., 2014; Ogle et al., 2013; Stokes et al., 2004; de Decker et al., 2003; Nixon et al., 2013, study 2; Meesters et al., 2000; Valentino et al., 2009). It should be noted that although Nixon et al. (2013, study 2) found an association between trauma exposure and rAMS, this was specific to the group with PTSD (and subthreshold PTSD). One study reported a negative effect, such that adolescents with MDD and a history of trauma were less overgeneral than adolescents with MDD and no trauma (Kuyken et al., 2006). Six studies (one unpublished) found no relationship between trauma exposure and OGM or rAMS (Hitchcock et al., 2014b; Hitchcock et al., N.d; Johnson et al., 2005; Nixon et al., 2013, study 1; Orbach et al., 2001; Valentino et al., 2012). Although Nixon et al. (2013, study 1) reported that trauma exposure was not correlated with rAMS they did however find that when constrained to recall memories within 24 hours post trauma, children were more specific. This was only found when the children displayed high levels of

acute stress symptoms (as measured via the Child PTSD Symptom Scale; CPSS; Foa, Johnson, Feeny, & Treadwell, 2001) in comparison to children scoring low or the control group. When the children were not constrained (i.e. could provide memories for anytime, in line with typical AM tasks) there were no group differences.

Controlling for depressive symptoms

Of the ten studies supporting the the role of trauma exposure on OGM, nine accounted for the role of depressive symptoms. Five studies controlled for symptoms of depression in their analysis (Crane et al., 2014; de Decker et al., 2003; Meesters et al., 2000; Ogle et al., 2013; Valentino et al., 2009) and four studies reported no difference between groups in symptoms of depression or confirmed that OGM was not associated with symptoms of depression (Brennen et al., 2010; Neshat Doost et al., 2014; Nixon et al., study 2; Stokes et al., 2004). It should be noted that when Crane and colleagues excluded children with probable depression at ages 7.5 and 10.5 years and this did not alter results; however, after controlling for symptoms of depression at aged 12.10 years, results were non-significant (although remained significant when data imputation was used). Arie et al. (2008) did not control for symptoms of depression but the suicide measure in their study included items that correlated with depression. Given that the suicidal group scored higher on this measure the possibility that the symptoms of depression may have accounted for the association between negative life events and greater overgeneral memory recall in the suicidal group cannot be ruled out. As nine of the 10 significant studies accounted for symptoms of depression, it is unlikely that the relationship between trauma exposure and memory specificity is due to symptoms of depression.

Clinical status comparisons

Of the studies reporting a relationship between trauma exposure and increased OGM, three included clinical populations (Arie et al., 2008; de Decker et al., 2003; Nixon et al.,

2013, study 2). Participants in these studies were diagnosed with a range of clinical diagnoses including borderline personality disorder, anorexia nervosa, conduct disorder and mood disorders and in one group a suicide attempt (Arie et al., 2008), inpatient adolescents who had not yet received formal diagnosis (de Decker et al., 2003), and one study which determined PTSD diagnosis based on a clinical interview (Nixon et al., 2013, study 2). The remaining studies were recruited from a diverse range of sources (e.g. from ongoing population studies, hospital patients, recruited from social services, youth care and community schools) and comprised of a community school sample without a diagnosis of clinical disorder (Brennen et al., 2010), community samples with no reference to previous or current clinical psychopathology (Neshat Doost et al., 2014; Stokes et al., 2004), a sample from an ongoing population-based study with exclusion of probable depression (Crane et al., 2014), and studies with trauma exposed samples, who were free from serious disorders (Ogle et al., 2013) and where some participants were, at most, in the subclinical range for self-reported depression (Valentino et al., 2009). Taken together, these findings suggest that the effect of trauma on OGM or rAMS is not an artefact of clinical disorder as it is reported in both clinical and a range of non-clinical samples.

Explained by heightened symptoms of PTSD?

Of the 10 studies that show a relationship between trauma exposure and increased OGM, three demonstrated that symptoms of PTSD were not related to OGM (Brennen et al., 2010; de Decker et al., 2003; Neshat Doost et al., 2014) and one study indicated no group differences in PTSD symptoms overall (Stokes et al., 2004). Crane et al. (2014) assessed probable PTSD and, as only one participant scored above a clinical cut off, they did not further consider the role of PTSD. Meesters et al. (2000) did not investigate symptoms of PTSD. Overall, five studies showed that symptoms of PTSD do not account for the relationship between trauma exposure and OGM or rAMS. One study however refutes this

view and suggest that PTSD could account for the relationship between trauma exposure and OGM. Nixon et al. (2013, study 2) reported that trauma exposed children with PTSD retrieved fewer specific memories in comparison to a trauma exposed non-PTSD control group. This suggests that it is PTSD which is associated with OGM and not trauma exposure per se. While Ogle et al. (2013) did not report findings on the relationship between PTSD and memory specificity in their adolescent sample only, they did note that heightened levels of PTSD was associated with memory specificity in a mixed adolescent and adult sample who reported childhood sexual abuse as their most traumatic life event. These findings however are in contrast to Kuyken et al. (2006) who found that adolescents with probable PTSD reported *less* OGM than those without a probable diagnosis of PTSD.

Nixon et al. (2013, study 1) reported that when constrained to recall memories from within 24 hours post trauma, children with high levels of acute stress symptoms were more specific than children scoring low, or those with no symptoms. Taken together, these findings show that the literature on the effect of symptoms of PTSD on the relationship between trauma history and OGM is mixed. It has been shown that having a trauma history is associated with OGM in the absence of symptoms of PTSD, while others have demonstrated that the trauma and OGM relationship was only found in a trauma group experiencing PTSD. It has also been shown that trauma exposed adolescents with symptoms of PTSD were more specific in their memory recall. It is evident that further, well controlled studies are needed to better establish the role of symptoms of PTSD in the relationship between trauma exposure and OGM.

Type of trauma and trauma measurement

The type of trauma could be a potential moderating factor in the relationship between trauma history and OGM. While Arie et al. (2008), Brennen et al. (2010), Meesters et al. (2000), Neshat Doost et al. (2014), Nixon et al. (2013: study 2), and Stokes et al. (2004) did

not examine the differences between different types of trauma exposure on memory specificity, Crane et al. (2014), de Decker et al. (2003), Ogle et al. (2013) and Valentino et al. (2009) provide information on different types of trauma. Valentino et al. (2009) proposed that certain memories such as sexual or physical abuse may elicit more distressing emotions and therefore result in greater OGM. The authors reported that abused (sexual and physical) children demonstrated greater OGM than neglected children or non-maltreated children. It should be noted that neglect, rather than relating to a specific incident, can be operationalised as a chronic omission of basic caregiving. This suggests that neglected children may not show OGM as there is no specific traumatic memory to avoid.

Crane et al. followed a cohort of children from toddlers (up to approximately two years nine months) to middle childhood (from five years up to approximately 11 years, two months). They noted that adolescents assessed at aged 13 who had experienced a severe trauma (defined as child removed from family, physical or sexual abuse) in middle childhood (from five years up to approximately 11 years, two months) were at a 60% increased risk of rAMS. Interestingly, the authors reported that exposure to moderate traumatic events (defined as having an ill mother, homelessness, mother and/or partner emotionally cruel to children) in middle childhood was associated with less OGM when assessed at aged 13, relative to participants with no exposures. This suggests that it is severe traumas that are particularly associated with OGM, however the specific type of trauma that is related to OGM remains unclear. de Decker et al. (2003) helped to provide further analysis on the effect of different types of trauma exposure on rAMS. While the authors noted evidence for a negative relationship between memory specificity and a total composed trauma score, further analysis of their data suggests that emotional, physical, and sexual abuse was specifically correlated with rAMS. Emotional neglect and sexual approach were not correlated with rAMS in their study.

Ogle et al. (2013) investigated the effect of childhood sexual abuse (CSA) on memory specificity. They reported that adolescents without a history of CSA reported more specific memories than adolescents with CSA histories. However, their results did not generalise when they examined severity when combining a history of CSA, physical abuse and neglect. Ogle et al.'s (2013) findings suggest that the link between trauma and OGM is specific to CSA. Taken together, findings suggest that emotional, sexual and physical abuse, childhood sexual abuse, and severe exposures to trauma are associated with OGM, relative to neglect, moderate exposures, emotional neglect, sexual approach and CSA, physical abuse and neglect combined.

Despite these promising advances, the literature with child and adolescent populations has produced mixed findings. For example, while war exposure, sexual, emotional and physical abuse, as well as negative life events have been associated with OGM (Arie et al., 2008; Brennen et al., 2010; Ogle et al., 2013; de Decker et al., 2003; Meesters et al., 2000), other studies included in the review have found no such support for similar events (Hitchcock et al., 2014b; Hitchcock et al., N.d; Johnson et al., 2005; Valentino et al., 2012). It does not seem as though the type of trauma can account for differing findings in the current review. However, given the heterogeneous samples, methodology and measurement of trauma exposure and OGM included in the current review, it is evident that further research to clarify the nature of the type of trauma on OGM is needed. The measurement of trauma exposure typically relies on retrospective self-report or parental reports (Arie et al., 2008; Crane et al., 2014; de Decker et al., 2003; Hitchcock et al., 2014b; Hitchcock et al., N.d) and retrospective reports have been subject to criticism in the literature (see Hardt & Rutter, 2004). However, not all research studies relied on self-report alone, some verified self-reported trauma via neuropsychologists (Brennen et al., 2010), parental reports (Stokes et al., 2004), and information from social workers, parents and children's reports (Orbach et al., 2001). Some

authors measure trauma from interviews (Johnson et al., 2005), interviews with parents (Nixon et al., 2013, study 1) or with questionnaires and clinical interviews (Kuyken et al., 2006). Documented cases of trauma from school records (Neshat Doost et al., 2014), youth care records (Meesters et al., 2000), therapy groups (Nixon et al., 2013, study 2), records held in child maltreatment diagnostic and treatment centres (Ogle et al., 2013) and child protective and preventive records (Valentino et al., 2009; Valentino et al., 2012) were used in the remaining studies. The relationship between trauma exposure and OGM does not seem to be an artefact of the trauma measure as the relationship was found across different levels of measurement.

Vulnerability to OGM

Little is known developmentally about how, why or when OGM develops after trauma exposure and prospective studies are warranted to highlight when and the way in which exposure leads to OGM. Three studies were able to longitudinally document trauma exposure throughout childhood, allowing for a proximal measure of exposure (Crane et al., 2014, Johnson et al., 2005; Orbach et al., 2001), but only Crane et al. (2014) found an association between trauma exposure and rAMS.. Crane et al.'s (2014) findings suggest that trauma exposure in middle childhood, in comparison to early life, was more strongly associated with OGM. Although these findings are valuable, the measure of OGM was not administered at each testing session (i.e. OGM was not assessed in early or middle childhood but only administered when the child was aged 13). It is therefore possible that trauma exposure in early life would have resulted in OGM at the time but any effect was diminished given the time lapse (over 10 years). While not a prospective design, Arie et al. (2008) provides support for that a trauma history in middle childhood may be particularly detrimental to OGM. Arie et al. (2008) in a retrospective study noted that it was negative life events in childhood (less than 12 years of age) that was related to OGM. Negative life events after the age of 12 were

not associated with OGM. Taken together, these findings suggest that exposure to trauma in middle childhood may be of particular importance. Future research that examines AMT performance and trauma exposure throughout childhood would be helpful in permitting a greater understanding of OGM.

Variations in tests of OGM

AM measurement across studies can be found in Table 2. The relationship between trauma exposure and OGM was reported across various tests of AM. For example, Meesters et al. (2000) applied the semantic autobiographical memory task (SAMT). Questions on the SAMT focussed on self-referent semantic information personal facts such as previous addresses or names of childhood friends. Despite not directly examining AM in typical format, Meesters and colleagues found adolescents with a history of trauma experienced greater difficulty in recalling autobiographical facts than the adolescents without such a history. It is possible that the traditional AMT was not sensitive enough to detect a relationship in non-clinical populations (Debeer et al., 2009) and could serve as an explanation for some null findings. While this may form a reason for null findings in some studies (Hitchcock et al., 2014b) it does not explain null findings (and reverse effects) in the remaining studies (Nixon et al., 2013, study 1; Valentino et al., 2009). These findings show that trauma exposure is related to OGM across different types of measurement and therefore it is unlikely that the relationship is due to the AMT measure.

Discussion

This review focussed on the applicability of the CaR-FA-X model (Williams et al., 2007) in child and adolescent populations and examined the published and unpublished literature to identify the contribution researchers have made to our understanding of OGM. The aim was to identify which mechanisms of the model were associated with and predictive of OGM in isolation or in interaction and numerous moderating factors were investigated. In

addition, the role of trauma exposure on memory specificity was investigated. As is often the case in systematic reviews, this process revealed gaps and trends within the literature, and recommendations for future research are offered.

The review findings concluded that capture errors were associated with OGM in child and adolescent populations. Rumination in isolation however, was only associated with OGM in a clinical population. Although Smets et al. (2013) did not find an association between rumination and OGM they did report that greater symptoms of depression were related to increases in OGM and decreases in memory specificity following a state rumination induction. This suggests that symptoms of depression moderate the effect of rumination on OGM. It may be that rumination in isolation is not associated with OGM in non-clinical populations but may be associated with OGM, in the context of greater symptoms of depression. Such findings provide a fruitful avenue for future research on the CaR mechanism. Given the different effects of brooding and reflective pondering in the literature (Arditte & Joormann, 2011; Burwell & Shirk, 2007; Gibb et al., 2012) and in the current review (Stewart et al., N.d) future research is needed to better establish the roles of the subcomponents of rumination on OGM

The literature on functional avoidance specifically was mixed and although a majority of studies supported the role of trauma exposure on OGM, seven studies did not. As noted in previous reviews (Sumner, 2012), this suggests that trauma exposure alone is not sufficient for the development of OGM. It may be that trauma in interaction with other mechanisms are better able to explain OGM in childhood and adolescence. Williams et al. (2007) suggest that trauma can result in OGM indirectly through impairment in executive control. The authors posit that effortful attempts to control intrusive thoughts relating to the trauma, as well as overriding processing, can result in reduced capacity of executive control. It is clear that there are many pathways in which trauma exposure can lead to OGM, yet little is known under

what circumstances the pathways lead to OGM in childhood and adolescence.

Developmentally, little is known about how, why or when OGM develops after trauma exposure and whether the age of the child at the time of the trauma has an impact on OGM.

While the findings of Crane et al. (2014) were very valuable as they provided a proximal measure of trauma exposure across childhood further research is needed. Future research that examines AMT performance, trauma exposure and avoidance throughout childhood would allow a greater understanding of the developmental aspect of functional avoidance.

The literature on impaired executive control was mixed. Two studies supported the relationship between impaired executive control (i.e. inhibition and verbal fluency) and OGM, two studies found greater working memory capacity to be associated with greater specificity and reduced OGM but did not find impairment to lead to less specificity or increased OGM. The majority of studies (nine) reported null findings. There is an array of theoretical issues concerning the measurement of executive control (see Davidson, Amso, Cruess, & Diamond, 2006; Diamond, 2013; Miyake et al., 2000) which are beyond the scope of this review but should be considered when examining cognitive functioning in child and adolescent populations. For example, it is debated whether working memory, inhibition and switching are related but separate (Miyake et al., 2000) and whether they rely on and build on each other (Davidson et al., 2006; Diamond, 2013). A review of executive control measures in childhood and adolescence further highlighted the changing, complex processes which underlie performance on executive tasks and suggested that results from such tasks can also be affected by a range of factors such as low applicability to real-life functioning (Hughes & Graham, 2002). These findings highlight multiple issues with the measurement and purity of executive control tasks and could serve as reasons for mixed findings within the review. Tasks that relate to real-life functioning such as processing faces shown as in the internal shift task (De Lissnyder et al., 2012) would be advantageous as faces have been shown to be

interpersonal and have ecological validity (Joormann & Gotlib, 2006; Raes, Hermans, & Williams, 2006).

The depression literature highlights that difficulty in executive control is heightened when processing emotional material (De Lissnyder, Koster, & De Raedt, 2012). Given that OGM is an underlying vulnerability factor to depression it is therefore questioned whether neutral valenced cognitive tasks are the best way to target a relationship between impairment in executive control and OGM. Given that a search can become aborted due to avoidance of negative affect (FA mechanism) it is possible that difficulty may also arise via the executive control mechanism with difficulty in processing emotional information in turn resulting in truncating the search at a general level of retrieval. Indeed, research with adolescent samples does highlight different pathways of emotional and non-emotional executive control on OGM (Stewart et al., N.d). Future research is needed that accounts for measurement issues within the executive literature as well as examining the different effects of impairment in executive control on OGM when processing emotional and non-emotional information.

Two of the four studies which investigated interactions between mechanisms of the CaR-FA-X model, found interactive effects. The prospective nature of these studies suggests rumination and executive control in interaction are an underlying vulnerability factor to later OGM, even after controlling for symptoms of depression and baseline OGM scores. These findings tap into separate, but related, research. Research with adolescents highlights a relationship between rumination and executive control, particularly when inhibiting emotional material (Hilt, Leitze, & Pollack, 2014). Williams et al. (2007) proposed that ruminative processing can hinder access to specific memories when executive control is impaired, which was supported by Rawal and Rice's (2012b) study with adolescents. Williams et al. (2007) also suggested that highly elaborate representations of the self which are accessed early in the search are generally more difficult to inhibit. A fruitful avenue for

future research would be to examine the self-relevance of the cues, rumination, and their interactive effects with low executive control. Given that reflective pondering was shown to have adaptive qualities within the executive control and OGM relationship, and that differences were reported between impairment in executive control when processing emotional and non-emotional representations, further research examining these factors presents an exciting avenue for future research. Examining these relationships across child development will provide a greater understanding of how the mechanisms of the CaR-FA-X model relate to OGM and further our knowledge of the developmental routes of OGM.

There is considerable heterogeneity between studies in regard to participant sample, age, measures and variables controlled in analyses, making it difficult to confidently draw conclusions. Similarly, few studies investigating the CaR-FA-X model reported statistical power thus increasing the difficulty in understanding whether null findings within the studies are due to problems with low statistical power. Given this variability, the review conclusions must be taken with caution.

Previous vs. current findings

The findings emerging from the systematic review differ from previous reports with predominantly adult populations. For example, a recent review of the CaR-FA-X model with predominantly adult studies (Sumner, 2012) found a robust support between rumination and impaired executive control on OGM and demonstrated that research findings on capture errors were mixed. In contrast, the systematic review in the current thesis found no support for rumination in non-clinical child and adolescent populations and reported that capture errors found across various task measures and found in multiple sample populations including non-clinical community samples and adolescents reporting a history of abuse (although there was two null findings). These findings highlight the importance of not drawing conclusions about child and adolescent populations from studies with adults. Thus, if capture errors and

rumination relate to OGM in a different way depending on the clinical status of child and adolescent populations, this has important implications for the design of future research. A recent review of child psychopathology (Hitchcock et al., 2014a), demonstrated that capture and rumination was associated with OGM (although this was based on only two studies).

The findings from the current systematic review are in line with previous reviews that support the role of trauma exposure on OGM (Sumner, 2012). While a majority of studies support the role of exposure on OGM, not all studies investigate trauma exposure on OGM supported the link. This is similar to reports by Moore and Zoellner (2007) who noted inconsistency findings of an association between trauma exposure and OGM. These findings are in contrast however to a previous review of the child and adolescent literature who noted that nine of ten studies supported the role of trauma exposure on OGM (Hitchcock et al., 2014a). While we looked at the role of the type of trauma exposure, we concluded, similar to Sumner (2012) that there is a lack of consistent support for the type of trauma having an effect on OGM. Echoing findings from Moore and Zoellner (2007) we suggest that further research is warranted before conclusions about the trauma exposure and OGM relationship can be reached. The role of functional avoidance more specifically (i.e. measurement of avoidance rather than trauma exposure) on OGM is less clear in child and adolescent populations to that of adult samples. Sumner's (2012) review and Williams et al. (2007) support the role of functional avoidance whereas the current review reported mixed findings. While there was documented support (albeit some null findings) for the role of trauma exposure on OGM, there was a lack of comparable studies specifically examining avoidance with child and adolescent populations (three studies) to draw conclusions from. This makes it difficult to draw comparisons to previous literature however it does present a possible opportunity for future research.

The role of impaired executive control on OGM appears to differ in child and adolescent studies in comparison to that of adults. Sumner's review (2012) found impaired executive control, especially deficits in inhibition, working memory capacity, the ability to update and maintain information in working memory, and verbal fluency to be associated with OGM, again further highlighting the differences between reviews that include adult populations and those specific to child and adolescent samples. Hitchcock et al. (2014a), like the current review findings, reported mixed results for inhibition, working memory capacity and verbal fluency in child and adolescent populations. We add to previous findings by examining studies which investigated working memory updating (null finding), switching ability (null finding) and more holistic measures of executive control (null findings in isolation).

Previous reviews with child and adolescent populations (Hitchcock et al., 2014a) have not investigated the interactive effects of multiple mechanisms on OGM and therefore current findings cannot be compared. Nonetheless, findings presented in the current thesis demonstrated a relationship between heightened levels of rumination and executive control on OGM. Such findings can only reinforce that when investigating the CaR-FA-X mechanisms as underlying vulnerabilities to OGM in child and adolescent populations, it is important to investigate the interactive effects between mechanisms. It may be that future research that investigates both rumination and executive control will be influential in accounting for more of the variance in OGM in child and adolescent populations.

Preliminary interaction studies are promising, but further research is needed that examines multiple mechanisms of the CaR-FA-X model. Williams et al. (2007) posit that one mechanism alone is not enough to explain all the OGM data, yet few studies examine multiple components and even less examine interactive effects. The CaR-FA-X model as a whole has not been examined in any published paper (one study has examined the entire

model but this has not been published, Hitchcock et al., N.d). It is evident that future research should address this issue as such work will allow for a holistic understanding of how the CaR-FA-X model can account for OGM. Future research should examine the role of reflective pondering further and identify any other adaptive or protective factors which could further our understanding of OGM and refine the CaR-FA-X model, specific to child and adolescent populations. Currently, there are too few studies investigating multiple mechanisms of the CaR-FA-X, and limited studies investigating the mechanisms of the model over time. However, these findings highlight a rich opportunity for future research.

At this stage, data from the studies reviewed provided adequate support for the CaR-FA-X model in child and adolescent populations. As OGM research has become more sophisticated, to include adaptive factors and as well as investigations of interactive effects between the CaR-FA-X mechanisms, methodological approaches within OGM research in child and adolescent samples should be advanced. The recommendations for future research presented throughout the review, as well as possible explanations provided for mixed results, will facilitate a greater understanding and refinement of how the CaR-FA-X model can account for OGM in child and adolescent populations.

References

- Abela, J. R. Z., Vanderbilt, E., & Rochon, A. (2004). A test of the integration of the response styles and social support theories of depression in third and seventh grade children. *Journal of Social and Clinical Psychology, 23*(5), 653–674. doi: 10.1521/jscp.23.5.653.50752
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Arie, M., Apter, A., Orbach, I., Yefet, Y., & Zalzman, G. (2008). Autobiographical memory, interpersonal problem solving, and suicidal behavior in adolescent inpatients. *Comprehensive Psychiatry, 49*(1), 22–29. doi: 10.1016/j.comppsy.2007.07.004
- Arditte, K. A. & Joormann, J. (2011) Emotion regulation in depression: Reflection predicts recovery from a major depressive episode. *Cognitive Therapy and Research, 35*(6), 536-543. doi: 10.1007/s10608-011-9389-4
- Brennen, T., Hasanovi, M., Zotovi, M., Blix, I., Skar, A-M. S., Preli, N. K. ... Gavrilov-Jerkovic, V. (2010). Trauma exposure in childhood impairs the ability to recall specific autobiographical memories in late adolescence. *Journal of Traumatic Stress, 23*(2), 240-247. doi: 10.1002/jts.20513
- Burwell, R. A., & Shirk, S. R. (2007). Subtypes of rumination in adolescence: Association between brooding, reflection, depressive symptoms and coping. *Journal of Clinical Child and Adolescent Psychology, 36*(1), 56-65. doi: 10.1207/s15374424jccp3601_6
- Compton, W. M., Conway, K. P., Stinson, F. S., & Grant, B. F. (2006). Changes in the prevalence of major depression and comorbid substance use disorders in the United States between 1991–1992 and 2001–2002. *The American Journal of Psychiatry, 162*(12), 2141-2147. doi: 10.1176/appi.ajp.163.12.2141

- Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 107(2), 261-288. doi: 10.1037//0033-295X.107.2.261
- Conway M. A., Singer J. A., & Tagini A. (2004). The self and autobiographical memory: Correspondence and coherence. *Social Cognition*, 22(5), 491–529. doi: 10.1521/soco.22.5.491.50768
- Crane, C., Heron, J., Gunnell, D., Lewis, G., Evans, J., & Williams, J. M. G. (2014). Childhood traumatic events and adolescent overgeneral autobiographical memory: findings in a U.K. cohort. *Journal of Behavior Therapy and Experimental Psychiatry*, 45(3), 330–338. doi: 10.1016/j.jbtep.2014.02.004
- Dagleish, T., Williams, J. M. G., Golden, A. J., Perkins, N., Barrett, L. F., Barnard, P., ... Watkins, E. (2007). Reduced specificity of autobiographical memory and depression: The role of executive control. *Journal of Experimental Psychology: General*, 136(1), 23–42. doi: 10.1037/0096-3445.136.1.23
- Davey, C. G., Yucel, M., & Allen, N. B. (2008). The emergence of depression in adolescence: development of the prefrontal cortex and the representation of reward. *Neuroscience & Biobehavioral Reviews*, 31(1), 1-19. doi: 10.1016/j.neubiorev.2007.04.016
- Davidson, M.C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, 44(11), 2037-2078. doi: 10.1016/j.neuropsychologia.2006.02.006
- Debeer, E., Raes, F., & Hermans, D. (2009). Associations between components of rumination and autobiographical memory specificity as measured by a Minimal Instructions Autobiographical Memory Test. *Memory*, 17(8), 892-903. doi: 10.1080/09658210903376243

- de Decker, A., Hermans, D., Raes, F., & Eelen, P. (2003). Autobiographical memory specificity and trauma in inpatient adolescents. *Journal of Clinical Child and Adolescent Psychology*, 32(1), 22–31. doi: 10.1207/15374420360533031
- De Lissnyder, E., Koster, E. H. W., & De Raedt, R. (2012). Emotional interference in working memory is related to rumination. *Cognitive Therapy and Research*, 36(4), 348-357. doi: 10.1007/s10608-011-9352-4
- De Lissnyder, E., Koster, E. H., Everaert, J., Schacht, R., Van den Abeele, D., & De Raedt, R. (2012). Internal cognitive control in clinical depression: General but no emotion specific impairments. *Psychiatry Research*, 199(2), 124–130. doi: 10.1016/j.psychres.2012.04.019
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135-168. doi: 10.1146/annurev-psych-113011-143750
- Drummond, L., Dritschel, B., Astell, A., O'Carroll, R. E., & Dalgleish, T. (2006). Effects of age, dysphoria and emotion-focusing on autobiographical memory specificity in children. *Cognition and Emotion*, 20(3-4), 488-505. doi: 10.1080/02699930500341342
- Dunn, V., & Goodyer, I. M. (2006). Longitudinal investigation into childhood- and adolescence-onset depression: psychiatric outcome in early adulthood. *The British Journal of Psychiatry*, 188, 216-222. doi: 10.1192/bjp.188.3.216
- Foa, E. B., Johnson, K. M., Feeny, N. C., & Treadwell, K. R. (2001). The Child PTSD Symptom Scale: A preliminary examination of its psychometric properties. *Journal of Clinical Child Psychology*, 30(3), 376–384. doi: 10.1207/S15374424JCCP3003_9
- Gibb, B. E., Grassia, M., Stone, L. B., & Uhrlass, D. J. (2012). Brooding rumination and risk for depression in children of depressed mothers. *Journal of Abnormal Child Psychology*, 40(2), 317-326. doi:10.1007/s10802-011-9554-y

- Griffith, J. W., Sumner, J. A., Raes, F., Barnhofer, T., Debeer, E., & Hermans, D. (2012). Current psychometric and methodological issues in the measurement of overgeneral autobiographical memory. *Journal of Behavior Therapy and Experimental Psychiatry*, 43, S21–S31. doi: 10.1016/j.jbtep.2011.05.008
- Hardt, J., & Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: review of the evidence. *Journal of Child Psychology and Psychiatry*, 45(2), 260–273. doi: 10.1111/j.1469-7610.2004.00218.x
- Heaton, R. K., Chelune, G. J., Talley, J. L., & Kay, G. G. (1993). *Wisconsin Card Sorting Test manual: Revised and expanded*. Odessa, FL: Psychological Assessment Resources.
- Herzog, R., Alvarez-Pasquin, M. J., Diaz, C., Del Barrio, J. L., Estrada, J.M., & Gil, A. (2013). Are healthcare workers' intentions to vaccinate related to their knowledge, beliefs and attitudes? a systematic review. *BioMed Public Health*, 13, 154. doi: 10.1186/1471-2458-13-154
- Higgins, J. P. T., & Green, S. (2011). *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]*. The Cochrane Collaboration, 2011. Retrieved from www.cochrane-handbook.org.
- Hilt, L. M., Leitzke, B. T., & Pollack, S. D. (2014). Cognitive control and rumination in youth: the importance of emotion. *Journal of Experimental Psychopathology*, 5(3), 302-313. doi: 10.5127/jep.038113
- Hitchcock, C., Nixon, R. D. V., & Weber, N. (2014a). A review of overgeneral memory in child psychopathology. *British Journal of Clinical Psychology*, 53(2), 170–193. doi: 10.1111/bjc.12034

- Hitchcock, C., Nixon, R. D. V., & Weber, N. (2014b). A longitudinal examination of overgeneral memory and psychopathology in children following recent trauma exposure. *Applied Cognitive Psychology*, 28(4), 531-538. doi: 10.1002/acp.3027
- Hitchcock, C., Nixon, R. D. V., & Weber, N. (N.d.). *A prospective examination of all CaR-FA-X mechanisms in predicting adolescents' autobiographical specificity*. Unpublished manuscript.
- Horowitz, L. M., Wilner, N., & Alvarez, W. (1979). Impact of event scale: A measure of subjective distress. *Psychosomatic Medicine*, 41(3), 209–218.
- Hughes, C., & Graham, A. (2002). Measuring Executive Functions in Childhood: Problems and Solutions. *Child and Adolescent Mental Health*, 7(3), 131-142.
doi: 10.1111/1475-3588.00024
- Johnson, R. J., Greenhoot, A., Glisky, E., & McCloskey, L. A. (2005). The relations among abuse, depression, and adolescents' autobiographical memory. *Journal of Clinical and Adolescent Psychology*, 34(2), 235–247. doi: 10.1207/s15374424jccp3402_3
- Joormann, J., & Gotlib, I. H. (2006). Is this happiness I see? biases in the identification of emotional facial expressions in depression and social phobia. *Journal of Abnormal Psychology*, 115(4), 705–714. doi: 10.1037/0021-843X.115.4.705
- Kleim, B., & Ehlers, A. (2008). Reduced autobiographical memory specificity predicts depression and posttraumatic stress disorder after recent trauma. *Journal of Consulting and Clinical Psychology*, 76(2), 231-242. doi: 10.1037/0022-006X.76.2.231
- Korczak, D. J., & Goldstein, B. I. (2009). Childhood onset major depressive disorder: course of illness and psychiatric comorbidity in a community sample. *Journal of Paediatrics*, 155(1), 118-123. doi: 10.1016/j.jpeds.2009.01.061

- Kovacs, M. (1992). *Children's Depression Inventory— Manual*. NY: Multi-Health Systems, Inc.
- Kuyken, W., & Dalgleish, T. (2011). Overgeneral autobiographical memory in adolescents at risk for major depression. *Memory*, 19(3), 241–250. doi: 10.1080/09658211.2011.554421
- Kuyken, W., Howell, R., & Dalgleish, T. (2006). Overgeneral memory in depressed adolescents with, versus without, a history of trauma. *Journal of Abnormal Psychology*, 115(3), 387-396. doi: 10.1037/0021-843X.115.3.387
- Lefebvre, C., Manheimer, E., & Glanville, J. (2008). Searching for studies. In Higgins, J. P. T., & Green, S (Eds). *Cochrane handbook for systematic reviews of interventions*. Chichester: Wiley-Blackwell. Retrieved from http://samples.sainsburysebooks.co.uk/9780470712177_sample_418122.pdf
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P., ... Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Medicine*, 6(7), e1000100. doi: 10.1371/journal.pmed.1000100
- Mackinger, H. F, Pachinger, M. M, Leibetseder, M. M., & Fartacek, R. R. (2000). Autobiographical memories in women remitted from major depression. *Journal of Abnormal Psychology*, 109(2), 331-334. doi: 10.1037//0021-843X.109.2.331
- Manly, T., Anderson, V., Nimmo-Smith, I., Turner, A., Watson, P., & Robertson, I. H. (2001). The differential assessment of children's attention: The Test of Everyday Attention for Children (TEA-Ch), normative sample and ADHD performance. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, 42, 1065–1081. doi:10.1017/S0021963001007909

- McPheeters, M. L., Kripalani, S., Peterson, N. B., Idowu, R. T., Jerome, R. N., Potter, S. A., Andrews, J. C. (2012). Closing the quality gap: revisiting the state of the science (vol. 3: quality improvement interventions to address health disparities). *Evidence report/technology assessment*, 208(3), 1-475.
- Meesters, C., Merckelbach, H., Muris, P., & Wessel, I. (2000). Autobiographical memory and trauma in adolescents. *Journal of Behavior Therapy and Experimental Psychiatry*, 31(1), 29–39. doi: 10.1016/S0005-7916(00)00006-9
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49-100. doi: 10.1006/cogp.1999.0734
- Moore, S. A., & Zoellner, L. A. (2007). Overgeneral autobiographical memory and traumatic events: An evaluative review. *Psychological Bulletin*, 133, 419–437. doi:10.1037/0033-2909.133.3.419
- Neshat Doost, H. T., Yule, W., Kalantari, M., Rezvani, S. R., Dyregrov, A., & Jobson, L. (2014). Reduced autobiographical memory specificity in bereaved Afghan adolescents. *Memory*, 6(6), 700–709. doi:10.1080/09658211.2013.817590
- Nixon, R. D. V., Ball, S., Sterk, J., Best, T., & Beatty, L. (2013). Autobiographical memory in children and adolescents with acute stress and chronic posttraumatic stress disorder. *Behaviour Change*, 30(3), 180–198. doi: 10.1017/bec.2013.17
- Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology*, 100(4), 569-582. doi: 10.1037/0021-843X.100.4.569

- Nuttall, A. K., Valentino, K., Comas, M., McNeill, A. T., & Stey, P. C. (2014). Autobiographical memory specificity among preschool-aged children. *Developmental Psychology*, 50(7), 1963-1972. doi: 10.1037/a0036988
- Ogle, C. M., Block, S. D., Harris, L. S., Goodman, G. S., Pineda, A., Timmer, S., ... Saywitz, K. J. (2013). Autobiographical memory specificity in child sexual abuse victims. *Development and Psychopathology*, 25(2), 321–332. doi: 10.1017/S0954579412001083
- Orbach, Y., Lamb, M. E., Sternberg, K. J., Williams, J. M. G., & Dawud-Noursi, S. (2001). The effect of being a victim or witness of family violence on the retrieval of autobiographical memories. *Child Abuse and Neglect*, 25(11), 1427–1437. doi: 10.1016/S0145-2134(01)00283-6
- Park, R. J., Goodyer, I.M., & Teasdale, J. D. (2002). Categorical overgeneral autobiographical memory in adolescents with major depression. *Psychological Medicine*, 32(2), 267–276. doi: 10.1017/S0033291701005189
- Park, R. J., Goodyer, I. M., & Teasdale, J. D. (2004). Effects of induced rumination and distraction on mood and overgeneral autobiographical memory in adolescent major depressive disorder and controls. *Journal of Child Psychology and Psychiatry*, 45(5), 996-1006. doi: 10.1111/j.1469-7610.2004.t01-1-00291.x
- Patra, P., Bhatia, M., Suraweera, W., Morris, S. K., Patra, C., Gupta, P. C., & Jha, P. (2015). Exposure to second-hand smoke and the risk of tuberculosis in children and adults: a systematic review and meta-analysis of 18 observational studies. *PLOS Medicine*, 12(6), e1001835. doi: 10.1371/journal.pmed.1001835
- Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., ... & Duffy, S. (2006). *Guidance on the conduct of narrative synthesis in systematic reviews: final report*. Swindon: ESRC Methods Programme.

- Raes, F., Hermans, D., & Williams, J. M. G. (2006) Negative bias in the perception of others' facial emotional expressions in major depression. *Journal of Nervous and Mental Disease, 194*(10), 796–799. doi: 10.1097/01.nmd.0000240187.80270.bb
- Raes, F., Verstraeten, K., Bijttebier, P., Vasey, M. W., & Dalgleish, T. (2010). Inhibitory control mediates the relationship between depressed mood and overgeneral memory recall in children. *Journal of Clinical Child and Adolescent Psychology, 39*(2), 276–281. doi: 10.1080/15374410903532684
- Rawal, A., & Rice, F. (2012a). Examining overgeneral autobiographical memory as a risk factor for adolescent depression. *Journal of the American Academy of Child and Adolescent Psychiatry, 51*(5), 518–527. doi: 10.1016/j.jaac.2012.02.025
- Rawal, A., & Rice, F. (2012b). A longitudinal study of processes predicting the specificity of autobiographical memory in the adolescent offspring of depressed parents. *Memory, 20*(5), 518-526. DOI: 10.1080/09658211.2012.683011
- Roberts, A.C. (1998). Introduction. In: Roberts, A.C., Robbins, T.W., Weiskrantz, L. (Eds.). *The Prefrontal Cortex: Executive and Cognitive Functions* (pp. 1-8). Oxford University Press: Oxford.
- Salzinger, S., Feldman, R. S., Hammer, M., & Rosario, M. (1992). Constellations of family violence and their differential effects on children's behavioral disturbance. *Child and Family Behavior Therapy, 14*, 23–41. doi: 10.1300/J019v14n04_03
- Sexton, K. A., & Dugas, M. J. (2008). The Cognitive Avoidance Questionnaire: Validation of the English translation. *Journal of Anxiety Disorders, 22*(3), 355-370. doi: 10.1016/j.janxdis.2007.04.005
- Schoofs, H., Hermans, D., & Raes, F. (2012). Effect of self-discrepancy on specificity of autobiographical memory retrieval. *Memory, 20*(1), 63-72. doi: 10.1080/09658211.2011.637934

- Shah, P., & Miyake, A. (1999). Models of working memory: an introduction. In: Miyake, A., Shah, P. (Eds.). *Models of Working Memory: Mechanisms of Active Maintenance and Executive Control* (pp. 1-27). Cambridge University Press: Cambridge.
- Shamseer L, Moher D, Clarke M, Ghera D, Liberati A, Petticrew M, ... Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P): elaboration and explanation. *British Medical Journal*, 349, g7647. doi: 10.1136/bmj.g7647
- Smets, J., Griffith, J. W., Wessel, I., Walschaerts, D., & Raes, F. (2013). Depressive symptoms moderate the effects of a self-discrepancy induction on overgeneral autobiographical memory. *Memory*, 21(6), 751-761. doi: 10.1080/09658211.2012.756039
- Smets, J., Wessel, I., & Raes, F. (2014). Reduced autobiographical memory specificity relates to weak resistance to proactive interference. *Journal of Behavior Therapy and Experimental Psychiatry*, 45(2), 234-241. doi: 10.1016/j.jbtep.2013.11.002
- Smith, P., Perrin, S., Dyregrov, A., & Yule, W. (2003). Principal components analysis of the impact of event scale with children in war. *Personality and Individual Differences*, 34(2), 315–322. doi: 10.1016/S0191-8869(02)00047-8
- Stewart, T., Hunter, S. C., & Rhodes, S. M. (2016). *A prospective investigation of rumination and executive control processes in predicting overgeneral autobiographical memory recall in adolescence*. Unpublished Manuscript.
- Stokes, D. J., Dritschel, B. H., & Berkerian, D. A. (2004). The effect of burn injury on adolescents' autobiographical memory. *Behaviour Research and Therapy*, 42(11), 1357-1365. doi: 10.1016/j.brat.2003.10.003

- Sumner, J. A. (2012). The mechanisms underlying overgeneral autobiographical memory: An evaluative review of evidence for the CaR-FA-X model. *Clinical Psychology Review*, 32(1), 34-48. doi: 10.1016/j.cpr.2011.10.003
- Sumner, J. A., Griffith, J. W., & Mineka, S. (2010). Overgeneral autobiographical memory as a predictor of the course of depression: a meta-analysis. *Behaviour Research and Therapy*, 48(7), 614–625. doi: 10.1016/j.brat.2010.03.013
- Sutherland, K., & Bryant, R. A. (2008). Social problem solving and autobiographical memory in posttraumatic stress disorder. *Behaviour Research and Therapy*, 46(1), 154-161. doi: 10.1016/j.brat.2007.10.005
- Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research*, 27(3), 247-259. doi: 10.1023/A:1023910315561
- Valentino, K. (2011). A developmental psychopathology model of overgeneral autobiographical memory. *Developmental Review*, 31(1), 32–54. doi: 10.1016/j.dr.2011.05.001
- Valentino, K., Bridgett, D. J., Hayden, L. C., & Nuttall, A. K. (2012). Abuse, depressive symptoms, executive functioning, and overgeneral memory among a psychiatric sample of children and adolescents. *Journal of Clinical Child and Adolescent Psychology*, 41(4), 491–498. doi: 10.1080/15374416.2012.660689
- Valentino, K., Toth, S. L., & Cicchetti, D. (2009). Autobiographical memory functioning among abused, neglected and non-maltreated children: The overgeneral memory effect. *Journal of Child Psychology and Psychiatry*, 50(8), 1029–1038. doi: 10.1111/j.1469-7610.2009.02072.x
- Van Noorden, M. S., Minkenberg, S. E., Giltay, E. J., Den Hollander-Gijsman, M. E., Van Rood, Y. R., Van Der Wee, N. J. (2011). Pre-adult versus adult onset major depressive

- disorder in a naturalistic patient sample: the Leiden Routine Outcome Monitoring Study. *Psychological Medicine*, 41(7), 1407–1417. doi: 10.1017/S0033291710002199
- van Vreeswijk, M. F., & de Wilde, E. J. (2004). Autobiographical memory specificity, psychopathology, depressed mood, and the use of the Autobiographical Memory Test: a meta-analysis. *Behaviour Research and Therapy*, 42(6), 731–743. doi: 10.1016/S0005-7967(03)00194-3
- Wells, G. A., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M., ... Tugwell, P. (n.d.). The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analysis. Retrieved from http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp.
- Wechsler, D. (2003). *Wechsler Intelligence Scale for Children (4th ed.)*. San Antonio, TX: The Psychological Corporation.
- Wechsler, D. (2004). *Wechsler Intelligence Scale for Children: Fourth UK edition*. London: Harcourt Assessment.
- Willebrand, M., Norlund, F., Kildal, M., Gerdin, B., Ekselius, L., & Andersson, G. (2002). Cognitive distortions in recovered burn patients: The emotional stroop task and autobiographical memory test. *Burns*, 28(5), 465–471. doi: [http://dx.doi.org/10.1016/S0305-4179\(02\)00052-9](http://dx.doi.org/10.1016/S0305-4179(02)00052-9)
- Williams, J. M. G. (1996). Depression and the specificity of autobiographical memory. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 244–267). Cambridge, England: Cambridge University Press.
- Williams, J. M. G., Barnhofer, T., Crane, C., Hermans, D., Raes, F., Watkins, E., ... Dalgleish, T. (2007). Autobiographical memory specificity and emotional disorder. *Psychological Bulletin*, 133(1), 122–148. doi: 10.1037/0033-2909.133.1.122

- Williams, J. M. G., & Broadbent, K. (1986). Autobiographical memory in suicide attempters. *Journal of Abnormal Psychology, 95*(2), 144-149. doi: 10.1037/0021-843X.95.2.144
- Yule, W., Tenbruggencate, S., & Joseph, S. (1994). Principal components analysis of the impact of events scale in adolescents who survived a shipping disaster. *Personality and Individual Differences, 16*(5), 685–691. doi: 10.1016/0191-8869(94)90210-0
- Ziegert, D. I., & Kistner, J. A. (2002). Response styles theory: Downward extension to children. *Journal of Clinical and Adolescent Psychology, 31*(3), 325–334. doi: 10.1207/153744202760082586

Tables and Figures

Table 1: *Quality assessment*

Cohort studies ¹		Selection		Comparability			Outcome		Total
Study	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that the outcome of interest was not present at start of the study	Comparability of cohorts on the basis of design or analysis	Assessment of outcome	Was follow-up long enough for the outcome to occur?	Adequacy of follow up of cohorts	
Crane et al. (2014)	*	*	*		**	*	*	*	8
Hitchcock et al. (2014b)	*	*	*	*	**	*	*	*	9
Hitchcock et al. (N.d)	*	*	*	*	**	*	*	*	9
Johnson et al. (2005)	*	*	*		**	*	*	*	8
Nixon et al. (2013) study 1	*	*	*	*	**	*	*	*	9
Rawal & Rice (2012b)	*	*	*	*	**	*	*	*	9
Stewart et al. (N.d)	*	*	*	*	**	*	*	*	9
Orbach et al. (2001)	*	*	*		*	*	*	*	7
Cross-sectional studies ²		Selection		Comparability			Outcome		Total
Study	Representativeness of the exposed sample	Non-respondents	Ascertainment of exposure	Comparability of outcome groups on the basis of design or analysis		Assessment of outcome	Statistical test is appropriate		
de decker et al. (2003)	*		*	**			*		5

Nuttall et al. (2014)	*		*	*		*		*		6
Park et al. (2004)	*		*	*		**		*	*	7
Raes et al. (2010)	*		*	*				*	*	5
Schoofs et al. (2012) study 1	*		*	*		*			*	5
Schoofs et al. (2012) study 2	*		*	*		*			*	5
Smets et al. (2013)	*			*		*		*	*	5
Smets et al. (N.d)	N/A		N/A	N/A		N/A		N/A	N/A	N/A
Case-control studies ³	selection				Comparability		Exposure		Total	
Study	Is the case definition adequate?	Representativeness of the cases	Selection of controls	Definition of controls	Comparability of cases and controls on the basis of design or analysis	Ascertainment of exposure	Same method of ascertainment for cases and controls	Non-response rate		
Arie et al. (2008) ⁴	*	*	*	*	*	*	*	*	8	
Brennen et al. (2010) study 1	*	*			**	*		*	6	
Kuyken et al. (2006)	*	*	*	*	**	*	*	*	9	
Meesters et al. (2000)		*	*	*	**		*	*	7	
Neshat Doost et al. (2014)	*	*	*	*	**	*	*	*	9	
Nixon et al. (2013) study 2	*	*		*	*	*	*	*	7	
Ogle et al. (2014)	*		*	*	**	*		*	7	
Valentino et		*	*	*	*	*	*	*	7	

al. (2012)										
Valentino et al. (2009)	*	*	*	*	**	*	*	*		9
Stokes et al. (2004)	*			*	**		*	*		6

¹Possible 9 stars, ²Possible 7 stars (adapted measure), ³Possible 9 stars

⁴Arie et al. (2008) was quality assessed as a case control study however the case definition applies here to clinical status (i.e. suicidal psychiatric group, psychiatric non suicidal control group and community control) rather than the case definition of a trauma group. The authors reported correlational (cross-sectional) data for the whole (mixed) sample when assessing the negative life events and OGM.

Table 2: *Summary table of outcome measurement variations*

Assessment of OGM								
Study (year)	Measure (author)	Time limit	Cue words	Cue delivery	Practice set	Memory type	Unit of measurement	Omissions
Arie et al. (2008)	AMT (no author but based on Williams & Broadbent, 1986)	60	10 words: Five words with positive connotations (happy, proud, calm, successful, surprised) and 5 words with negative connotations (sorry, angry, guilty, heart, lonely)	Not stated	No (they were given 2 additional chances, each with a 60-second limit if no specific memory was given within 60s)	OGM (all memories except specific and omission)	Number	Recorded
Brennen et al. (2010) study 1	AMT: (Williams & Broadbent, 1986). Norwegian and Bosnian translations	2 minutes	12: 5 positive (happy, safe, interested, successful, and surprised). 5 negative (sad, angry, clumsy, hurt, and lonely). 2 more positive words were included (optimistic and victory)	Oral	Yes	Specific, categoric, extended and no responses	Proportion	Recorded
Crane et al. (2014)	AMT: Williams & Broadbent, 1986). Written version	None	10: 5 positive (excited, happy, lucky, relaxed, relieved). 5 negative (bored, failure, hopeless, lonely, sad)	Written	No (examples were given)	Binary score used: lowest quartile (providing at most one specific memory response) versus the remainder.	Number	Included as a non-specific memory
De decker et al. (2003)	AMT Dutch version (de Decker, 2001) of the AMT (Williams & Broadbent, 1986)	30 seconds	10: 5 positive (happy, safe, interested, successful, surprised), 5 negative (sad, angry, clumsy, emotionally hurt, lonely)	Oral	No	Specific	Number	Not stated
Hitchcock et al. (UP)	AMT (Williams &	60 seconds	10: Time 1 (happy, sad, easy, lonely, proud, scared, brave, angry, successful, broken) and	Written and oral	Not stated	Specific	Number	Recorded

Hitchcock et al. (2014b)	Broadbent, 1986) Written version AMT (Williams & Broadbent, 1986)	60 seconds	Time 2 (happy, sad, friend, stupid, surprised, tears, smart, mad, playing, afraid) Three word sets (5 positive & 5 negative in each) Word set 1: Happy, sad, easy, lonely, proud, scared, brave, angry, successful, broken. Word set 2: Happy, sad, friend, stupid, surprised, tears, smart, mad, playing, afraid. Word set 3: Happy, sad, beautiful, hurt, safe, sorry, lucky, upset, interested, alone	Written and oral	Yes	OGM (categoric and extended)	Number	Recorded
Johnson et al. (2005)	AMT (Crovitiz et al., 1980)	3 minutes	Not stated: three types of cue words: positive (e.g., “present,” “playing”), neutral (e.g., “car,” “shopping”), negative (e.g., “punishment,” “arguing”).	Not stated	Not stated	Specific	Generate as many specific as possible from before age 9 in time limit	Not stated
Kuyken et al. (2006)	AMT (Williams, 2000).	30 seconds	10: 5 positive (happy, hopeful, excited, proud and loved) and 5 negative (lonely, frightened, sad, angry and ashamed)	Flashcards	Yes	OGM (categoric and extended)	Number	Recorded
Meesters et al. (2000)	SAMT (Meesters et al., 2000)	Not stated	No cue words Sentences (e.g. the name of the street lived on)	Not stated	Not stated	No. of correct responses / by total no. of items - the number of non-relevant items	Number	Not stated
Neshat Doost et al. (2014)	AMT (Williams & Broadbent, 1986)	30 seconds	18: 6 positive (park , play , praise, party , celebration, holiday), 6 negative (accident , loneliness , argument, death break-up, illness), 6 neutral (year, book, class, clothes house, desk).	Written	Yes	Specific, categoric, extended, and semantic associates	Proportion (total of each memory type was divided by total no. of memories provided)	Recorded
Nixon et al. (2013) study 1	AMT: constrained and unconstrained ¹	60 seconds	10: Ten affect words were presented on 5 positive (happy, brave, safe, strong, interested), 5 negative words (lonely, doubt,	Flashcards	Yes	Specific	Number	Recorded

Nixon et al. (2013) study 2	(Williams & Broadbent, 1986) AMT (Williams & Broadbent, 1986)	60 seconds	hurt, strange, clumsy) 10: Ten affect words were presented on 5 positive (happy, brave, safe, strong, interested) 5 negative words (lonely, doubt, hurt, strange, clumsy)	Flashcards	Yes	Specific	Number	Recorded
Nuttall et al. (2014)	AMT-PV ² (Nuttall et al., 2014)	60 seconds	10: 5 positive (happy, surprised, lucky, strong, smart), 5 negative (mad, sad, scared, tired, hungry)	Oral and visually	Not stated	Specific (coded 1 for specific and 0 for all other memories)	Number	Coded as OGM
Ogle et al. (2013)	The AMI ³ (Kopelman et al., 1989)	None	No cue words: recalled an incident that occurred in elementary school (Grades 1–5; aged 5–10), and an incident that occurred during sixth grade (aged 12)	Not stated	No (examples were given)	Specific	Number	Recorded
Orbach et al. (2001)	The FDQ ⁴ (Salzinger, Feldman, Hammer, & Rosario, 1992)	Not stated	No cue words: Questions asked the child to describe issues, incidence, and characteristics of child-parent and interparental disagreements, arguments, disputes, parental punishment, and parental physical violence	N/A	No	Categoric	Proportion	Recorded
Park et al. (2004)	AMT (Williams & Broadbent, 1986)	60 seconds	4 word sets were used (6 positive & 6 negative in each set) Word set 1: happy, relieved, proud, eager, glorious, sunny, guilty, hopeless, grave, ugly, worse, failure; Word set 2: interested, hopeful, amazed, pleased, calm, bright, grief, rejected, lonely, blame, awful, mistake; Word set 3: joy, smile, loyal, lively, cheer, lucky, sad, misery, ashamed, weakness, angry, tired; Word set 4: safe, excited, friendly, peaceful, successful, pleasant, tragic, upset, hurt, bad, bored, fault	Flashcards	Yes	Categoric	Proportion	Recorded
Raes et al. (2010)	AMT: Written version (Williams &	Not stated	10: 5 positive (happy, relaxed, successful, brave, proud), 5 Negative (scared, lonely, angry, sad, guilty)	Written	Not stated	Categoric	Number	Recorded

Rawal and Rice (2012b)	Broadbent, 1986) AMT (Williams & Broadbent, 1986)	30 seconds	Two word sets consisting of 12 emotional: 6 positive (Word-set 1: loyal, joy, smile, achieve, loved, ambitious; Word-set 2: friendly, happy, respect, caring, sunny, perfect) 6 negative (Word-set 1: mistake, rejected, weakness, needy, angry, tired; Word-set 2: failure, disliked, ugly, useless, worse, lonely).	Read aloud	Yes	Specific	Number	Not stated
Schoofs et al. (2012) study 1& 2	Mi-AMT: written version (Williams & Broadbent, 1986) (Written; Debeer et al., 2009)	60 seconds	20 words: Only positive 10 high discrepant (example - optimistic, successful, and satisfied); 10 low discrepant (example - sensitive, grateful, and polite)	Not stated	No	Specific and Categorical	Proportion (no. of specific memories / by no. of total responses (10 - no. of no responses))	Excluded in proportion calculations
Smet et al. (2013)	Mi-AMT: written version (Williams & Broadbent, 1986) (Written; Debeer et al., 2009)	60 seconds	20 words: Only positive 10 high discrepant (example - optimistic, successful, and satisfied); 10 low discrepant (example - sensitive, grateful, and polite)	Read aloud	No	Specific and categorical	Number	Recorded
Smets et al. (UP as cited in Smets et al., 2013)	Mi-AMT: written version (Williams & Broadbent, 1986) (Written; Debeer et al., 2009)	60 seconds	10 words: 10 high discrepant cues (these are positive, emotional words which may bring discrepancies between a current state and desired, ideal goals into prominence).	NK	NK	Categorical	Number	NK
Stewart et al. (UP)	Mi-AMT: written version (Williams & Broadbent, 1986) (Written; Debeer et al., 2009)	60 seconds	Two word sets consisting of 12 emotional: 6 positive (Word-set 1: loyal, joy, smile, achieve, loved, ambitious; Word-set 2: friendly, happy, respect, caring, sunny, perfect) 6 negative (Word-set 1: mistake, rejected, weakness, needy, angry, tired; Word-set 2: failure, disliked, ugly, useless, worse, lonely).	Oral and Visual	No (examples were given)	OGM (categorical and extended)	Number	Recorded

Stokes et al. (2004)	Cued recall task (no author)	60 seconds	10 emotional cue words. 5 positive cue words (Happy, Safe, Interested, Successful, Surprised) 5 negative words (Sorry, Angry, Clumsy, Hurt, Lonely)	Not stated	No (examples were given)	Specific, extended, categoric and omissions	Number	Recorded
Valentino et al. (2012)	AMT (Williams & Broadbent, 1986)	60 seconds	10 cue words: 5 positive and 5 negative (example - happy, sorry)	Oral and visual	Not stated	OGMs defined as memories that did not contain at least one specific detail	Number	Not stated
Valentino et al. (2009)	AMT (Williams & Broadbent, 1986)	60 seconds	10: 5 positive cue words (Happy, Safe, Interested, Successful, Surprised), 5 negative words (Sorry, Angry, Clumsy, Hurt, Lonely)	Oral and visual	Not stated	OGMs defined as memories that did not contain at least one specific detail	Number	Not stated

¹ Unconstrained condition = recall a specific event from any time period of their life, prior to the recent trauma/hospital admission. Constrained condition = recall a specific event from the time of trauma, up to 24 hours following the event in response to the cue words.

² The AMT-PV is an adaptation of the original AMT (Williams & Broadbent, 1986) that was designed to be developmentally appropriate for pre-school children.

³AMI = Autobiographical memory interview (Kopelman et al., 1989)

⁴FDQ = Family Disagreements Questionnaire (FDQ: Salzinger, Feldman, Hammer, & Rosario, 1992)

AMT = autobiographical memory test; Mi-AMT = minimal instruction autobiographical memory test

Table 3: *Summary of studies examining the mechanisms of the CaR-FA-X model*

Studies (year)	No. of participants (% male)	Sample (no. in group)	Age (mean and SD)	Assessment of OGM (unit of measurement)	CaR-FA-X mechanism (task)	Finding(s)	Support CaR-FA-X model
<i>Capture and Rumination Studies</i>							
Park et al. (2004)	134 (Full MDD = 30%; PR-MDD = 26%; Non-MDD PSY = 38%; Control = 38%)	Clinical: (Full MDD = 44; PR MDD = 31; Non-MDD PSY = 26; Control = 33)	12-17 years: (Full MDD, M = 14.90, SD = 1.3; PR-MDD, M = 15.00, SD = 1.4; Non-MDD PSY, M = 13.70, SD = 1.4; Control, M = 14.60, SD = 1.3)	AMT: (prop. of categoric)	R: (Rumination vs. distraction induction)	Greater increase in OGM after rumination induction than with distraction in the MDD (collapsed with partially remitted) group only. This effect was specific to negative cue words.	R: Yes
Schoofs et al. (2012) study 1	126 (21%)	Non-clinical: Community sample	17-20 years (M = 17.57, SD = 0.66)	AMT: minimal instruction, written (prop. of specific and categoric)	C: (high & low discrepant words) R: (brooding and reflective)	A greater proportion of specific memories were retrieved in response to LD cues compared to HD cues. A greater proportion of categoric memories were retrieved in response to HD cues compared to LD cues. BR and RP not associated with OGM.	C: Yes R: No
Schoofs et al. (2012) study 2	146 (45%)	Non-clinical: Community sample	16-19 years (M = 16.82, SD = 0.72)	AMT: minimal instruction, written (prop. of specific and categoric)	C: (high low discrepant words) R: (brooding and reflective)	A greater proportion of specific memories were retrieved in response to LD cues compared to HD cues. A greater proportion of categoric memories were retrieved in response to HD cues compared to LD cues. BR and RP not associated with OGM.	C: Yes R: No
Smets et al. (2013)	123 (45%)	Non-clinical: Community sample	16-19 years (M = 17.30, SD = 0.50)	AMT: minimal instruction, written (no. of specific and categoric)	C: (self-discrepancy induction) R: (RRS; Dutch version)	Rumination was not associated with OGM before or after self-discrepant induction.	C: No R: No

Smets et al. (N.d as cited in Smets et al., 2013)	246 (39%)	Non-clinical: Community sample	Unknown (M = 17.30)	AMT: minimal instruction, written (no. of categoric)	C: (high low discrepant words)	Self-discrepancies did not result in greater OGM.	C: No
Valentino et al. (2009)	192 (Sexual and physical abuse = 67%; neglected = 56%; non-maltreated = 47%)	Non-clinical trauma exposed: (Sexual and physical abuse = 36; neglected = 34; non-maltreated = 115)	7 -13 years (total, M = 10.61, SD = 1.55; Sexual and physical abuse = M = 10.69, SD = 1.6; neglected = M = 10.78, SD = 1.7; non-maltreated = M = 10.51, SD = 1.5)	AMT (no. of OGM, not containing at least one specific detail)	C: Child and maternal self-representations	Negative self-representations positively associated with OGM (in abused and non-maltreated groups combined).	C: Yes
<i>Functional Avoidance Studies</i>							
Stokes et al. (2004)	24 (0%)	Non-clinical trauma exposed: Burns group = 12; orthodontic controls = 12)	11-16 years (M = 14 years)	Cued recall task: (no. of specific, categoric, extended)	TE: Burns between 6 weeks old & 14 years (parental reports) A: Impact event scale	In the burn group, reduced specificity was correlated with higher avoidance.	FA: Yes
<i>Impaired executive control</i>							
de Decker et al. (2003)	27 (63%)	Clinical: Psychiatric inpatient	14-20 years (M = 16.40, SD = 1.5)	AMT: (no. of specific)	X: WM capacity	Working memory capacity not associated with memory specificity.	X : No
Johnson et al. (2005)	134 (46%)	Non-clinical trauma exposed: Exposure to family violence and sexual abuse	Year 1: 6 – 12 years (M = 9.00, SD = 1.98; Year 6 : 12 – 18 years (M = 15.00, SD = 1.97)	AMT: Crovitz et al.,1980 (Generate as many specific within time limit)	X: WM capacity	WM capacity was not associated with OGM or memory specificity.	X : No
Meesters et al. (2000)	27 (trauma group = 30%; no trauma group = 29%)	Non-clinical trauma exposed: Adolescents in youth care (Trauma = 10; no-trauma =17)	14-19 years (Trauma group, M = 16.50, SD = 1.3; no trauma group, M = 16.10, SD = 2.8)	SAMT: (no. of correct responses divided by the total number of items minus the number of non-relevant items) AMT:	X: WM capacity	WM capacity not associated with AM.	X : No
Nixon et	67 (High acute	Non-clinical trauma	8-17 years (High		X : WM capacity	Greater WMC was associated with	X: Yes

al. (2013) study 1	PTSD stress = 36%; low acute PTSD stress = 71%; control = 66%)	exposed: Children attending hospital for a single-incident trauma and hospitalised control for non-trauma related illnesses (High acute stress = 11; low acute stress = 24; control = 32)	acute PTSD stress, M = 13.27, SD = 2.72; low acute PTSD stress, M = 12.33, SD = 2.90; control, M = 12.78, SD = 3.01)	Constrained vs unconstrained (no. of specific)		greater memory specificity.	(partial)
Nixon et al. (2013) study 2	67 PTSD (58%) Control (59%)	Clinical*: Trauma exposed children with PTSD receiving CBT treatment vs trauma-exposed but non-PTSD children recruited from the community (PTSD = 33; control = 34)	7-16 years (PTSD, M= 11.12, SD = 3.12; control, M = 11.06, SD = 2.10)	AMT (no. of Specific)	X: WM capacity	WMC was not associated with memory specificity.	X : No
Nuttall et al. (2014)	227 (4 year olds = 52%; 5 year olds = 51%; 6 year olds = 48%)	Non-clinical: Community pre-school sample: (4 year olds = 79; 5 year olds = 63; 6 year olds = 65)	4-6 years (4 year olds, M = 4.52, SD = 0.27; 5 year olds, M = 5.49, SD = 0.29; 6 year olds, M = 6.52, SD = 0.28)	AMT-PV ³ : (no. of specific)	X: Behavioural inhibition	Behavioural inhibition not association with OGM in the preschool sample.	X : No
Raes et al. (2010)	135 (47%)	Non-clinical: Community sample	9-13 years (M = 10.53, SD = .66)	AMT Written: (no. of categoric)	X: Inhibition	Lower levels of inhibitory control were associated with greater recall of categoric memories.	X : Yes
Valentino et al. (2012)	49 (67%)	Clinical: Psychiatric inpatient (Physical and sexual abuse = 30; no abuse = 19)	7 -17 years (Total, M = 14.10, SD = 2.3; Abuse, M = 13.49, SD = 2.3; No abuse, M = 15.28, SD = 1.6)	AMT (no. of OGM, not containing at least one specific detail)	X: Shifting, inhibition, verbal fluency (letter & category fluency)	Shifting, letter fluency and inhibition not correlated with OGM. Category fluency associated with OGM.	X: Yes (only for category fluency)
<i>2 mechanisms</i>							
Hitchcock et al. (2014b)	50 (75%)	Non-clinical trauma exposed: Children attending hospital	7 – 17 years (M = 11.90, SD = 3.31)	AMT (No. of OGM, categoric & extended)	R: CRSS TE: trauma questionnaire	Rumination not associated with OGM. WM updating, verbal fluency and	R: No X: Yes (partial &

		for a single incident accidental injury		combined)	X: WM capacity, WM updating, verbal fluency & inhibition R&X: Rumination x executive control	inhibition not associated with OGM. Greater WM capacity was associated with reductions in OGM (in older children) but greater WM in younger children was associated with greater OGM. Greater WM capacity and high levels of inhibition positively associated with OGM. No interactive effects between executive control and rumination.	only for WM capacity & older children) R&X: No
Kuyken et al. (2006)	62 (Never depressed = 25%; depressed no trauma = 25%; depressed and trauma = 9%)	Clinical: (Never depressed = 28; depressed no trauma = 12; depressed + trauma = 22)	12-18 (Never depressed, M=15.68, SD= 1.59; depressed no trauma, M=15.92, SD=1.51; depressed and trauma, M=16.23, SD = 1.38)	AMT: (no. of OGM, categoric and extended combined)	A: The Children's Impact of Event Scale X: Verbal fluency	In the trauma plus MDD group, higher levels of avoidance was associated with <i>less</i> OGM Across the whole sample, verbal fluency was not associated with OGM.	FA: No X : No
Rawal and Rice (2012b)	230 (42%)	Non-clinical: At familial risk of depression	10-18 years (M = 13.64, SD = 1.98)	AMT: (no. of specific)	R: The Children's Response Styles Questionnaire X: Visuo- constructional ability R&X: Rumination x executive control	Rumination in isolation not associated with OGM. EC not association with OGM in isolation. Interaction: rumination in the context of low EC predicts OGM at follow up.	R: No X: No R&X: Yes
Stewart et al. (N.d)	149 (37%)	Non-clinical: Community sample	13-16 years (M = 13.85, SD = 0.78)	AMT: (no. of OGM, categoric and extended combined)	R: RRS scale X: Executive control R&X: Rumination x executive control	Rumination in isolation is not associated with OGM. Impairment in executive control is not associated with OGM in isolation. Interaction: Low executive control for emotional information, with increased levels of reflective pondering predicted less OGM at follow up.	R: No X: No R&X: Yes

<i>3 mechanisms</i>							
Hitchcock et al. (N.d)	196 (47%)	Non-clinical: Community sample	12- 17 years (M = 14.18, SD = 1.58)	AMT Written (no. of specific)	R: CRSS TE: PTSD Scale for trauma history A: Cognitive avoidance X: Inhibition R,X& TE: Trauma history x rumination; inhibition x trauma	Rumination, inhibition, nor avoidance was independently or in interaction associated with memory specificity.	R: No FA: No X: No R,X&FA: No

AMT = autobiographical memory test; CRSS = The Children's Response Style Scale; MDD = major depressive disorder; PR = partially remitted; PSY = psychiatric sample; prop = proportion, no. = number of; neg = negative; RRS = ruminative response scale; LD = low discrepant, HD = high discrepant; ns = non-significant; R = rumination; C = capture; FA; functional avoidance; X = executive control;

¹ Autobiographical memory interview (Kopelman et al., 1989)

² FDQ = Family Disagreements Questionnaire (FDQ: Salzinger, Feldman, Hammer, & Rosario, 1992)

³ The AMT-PV is an adaptation of the original AMT (Williams & Broadbent, 1986) that was designed to be developmentally appropriate for pre-school children

⁴Follow up study 2 not included as mean age above 18 years old.

*39% of sample failed to meet to full criteria for 1 of the 3 symptom clusters

Table 4: Summary of studies examining the trauma exposure

Studies (year)	No. of participants (% male)	Sample (no. in group)	Age (mean and SD)	Assessment of OGM (unit of measurement)	Type of trauma	Finding(s)	Support
<i>Trauma Exposure Studies</i>							
Arie et al. (2008)	75 (Suicide attempt group = 35%; psychiatric control = 40%; community control = 48%)	Clinical: psychiatric inpatient (Suicide attempt group = 25; psychiatric control = 25; community control = 25)	12 – 19 years (Suicide attempt group, M = 16.50 ± 2.5 years; psychiatric control, M = 16.50 ± 2.5 years; community control, M = 16.6 ± 2.3 years)	AMT: no author (no. of OGM – defined as non-specific responses)	Life (including events at school, parents, family and health events)	In comparison to the psychiatric and community control group, negative life events in childhood were correlated with OGM in the suicide psychiatric group.	Yes
Brennen et al. (2010) study 1 ¹	89 (Trauma group = 50%; control group = 46%)	Non-clinical trauma exposed: (Trauma group = 40; control group = 49)	17-19 years (Trauma group, M = 17.90, SD = 0.70; control group, M = 18.00, SD = 0.50)	AMT (prop of specific and categoric)	War trauma	Bosnian group (war exposure) recalled fewer specific memories and more categoric memories than the Norwegian group (non-war exposure group).	Yes
Crane et al. (2014)	5,792 (43%)	Non-clinical: Children from ongoing population study	13 years (95% between 13 years, 1 month & 13 years, 3 months)	AMT written: (no. of specific lowest quartile, binary)	Life events (severe events include death of a family member, physical or sexual abuse)	60% increase in the odds of low memory specificity at aged 13 for children who had experienced severe trauma in middle childhood.	Yes
de Decker et al. (2003)	27 (63%)	Clinical: Psychiatric inpatient	14-20 years (M = 16.40, SD = 1.5)	AMT: (no. of specific)	Physical abuse, sexual approach and abuse	Greater trauma was associated with less specificity. This effect was specific to positive cue words.	Yes
Hitchcock et al. (N.d)	196 (47%)	Non-Clinical: Community school sample	12- 17 years (M = 14.18, SD = 1.58)	AMT Written (no. of specific)	Sexual assault/abuse, physical assault/abuse, or war exposure	Trauma exposure was independently or in interaction associated with memory specificity.	No

Hitchcock et al. (2014b)	50 (75%)	Non-clinical: Children attending hospital for a single incident accidental injury	7 – 17 years (M = 11.90, SD = 3.31)	AMT (No. of OGM, categoric & extended combined)	Adverse life events (including death of a family member)	Trauma history not associated with OGM.	No
Johnson et al. (2005)	134 (46%)	Non-clinical: Exposure to family violence and sexual abuse	Year 1: 6 – 12 years (M = 9.00, SD = 1.98; Year 6 : 12 – 18 years (M = 15.00, SD = 1.97)	AMT: Crovitz et al.,1980 (Generate as many specific within time limit)	Family violence and sexual abuse	Family violence or sexual abuse not related to specific memories or OGM at year 1 or 6.	No
Kuyken et al. (2006)	62 (Never depressed = 25%; depressed no trauma = 25%; depressed and trauma = 9%)	Clinical: (Never depressed = 28; depressed no trauma = 12; depressed + trauma = 22)	12–18 (Never depressed, M=15.68, SD= 1.59; depressed no trauma, M=15.92, SD=1.51; depressed and trauma, M=16.23, SD = 1.38)	AMT: (no. of OGM, categoric and extended combined)	Events (including serious car accidents, physical assault, sexual abuse, severe violence)	Adolescents with MDD and a history of trauma were <i>less</i> overgeneral than adolescents with MDD with no trauma.	No
Meesters et al. (2000)	27 (trauma group = 30%; no trauma group = 29%)	Non clinical: Adolescents in youth care (Trauma = 10; no-trauma =17)	14-19 years (Trauma group, M = 16.50, SD = 1.3; no trauma group, M = 16.10, SD = 2.8)	SAMT: (no. of correct responses divided by the total number of items minus the number of non-relevant items)	Physical maltreatment, sexual abuse & neglect	Adolescents with a history of trauma have greater difficulty reporting autobiographical facts than adolescents without a history of trauma.	Yes
Neshat Doost et al. (2014)	103 (Bereaved = 50%; non-bereaved = 58%)	Non-clinical: (Bereaved = 70; non-bereaved = 33)	12-18 years (bereaved, M = 14.89, SD = 1.83; non-bereaved (M = 14.91, SD = 2.05)	AMT: (prop. of specific, categoric & extended)	Paternal war death (10 + years ago)	Bereaved group retrieved a lower proportion of specific memories and a higher proportion of categoric and extended memories than the non-bereaved group.	Yes
Nixon et al. (2013) study 1	67 (High acute PTSD stress = 36%; low acute PTSD stress = 71%; control = 66%)	Non-clinical: Children attending hospital for a single-incident trauma and hospitalised control for non-trauma related illnesses (High acute	8-17 years (High acute PTSD stress, M = 13.27, SD = 2.72; low acute PTSD stress, M = 12.33, SD = 2.90; control, M =	AMT: Constrained vs. unconstrained (no. of specific)	Events (including road traffic accidents, assault, burns)	When constrained to retrieve memories from the 24-hour period following trauma, children with higher levels of acute PTSD stress symptoms retrieved a <i>greater</i> number of	No

		stress = 11; low acute stress = 24; control = 32)	12.78, SD = 3.01)			specific memories. No differences unconstrained condition.	
Nixon et al. (2013) study 2	67 PTSD (58%) Control (59%)	Clinical*: Trauma exposed children with PTSD receiving CBT treatment vs trauma-exposed but non-PTSD children recruited from the community (PTSD = 33; control = 34)	7-16 years (PTSD, M= 11.12, SD = 3.12; control, M = 11.06 , SD = 2.10)	AMT (no. of Specific)	Events (including road traffic accidents, assault, death of relative)	Trauma exposed children with PTSD retrieved fewer specific memories compared to trauma exposed non-PTSD controls.	Yes
Ogle et al. (2013)	85: 49 adolescents (14% whole sample of 85)	Non-clinical: Childhood sexual abuse = 25; control = 24)	14-17 years (M = 15.12, SD = 0.95)	The AMI ² : (no. of specific)	CSA history	Adolescents without CSA histories reported more specific memories than adolescents with CSA histories.	Yes
Orbach et al. (2001)	50 (not stated)	Non-clinical: (Family violence = 34; control = 16)	8 – 12 years (M = 10.61, SD = 1.31)	The FDQ ³ : (prop. of categoric)	Family Violence	No group differences in OGM in between children in the Family Violence (Victims of Abuse, Witnesses of Abuse, and Victims and Witnesses) and Comparison groups.	No
Stokes et al. (2004)	24 (0%)	Non-clinical: Burns group = 12; orthodontic controls = 12)	11-16 years (M = 14 years)	Cued recall task: (no. of specific, categoric, extended)	Burns between 6 weeks old & 14 years	The burn group recalled significantly fewer specific memories and more extended memories.	Yes
Valentino et al. (2012)	49 (67%)	Clinical: Psychiatric inpatient (Physical and sexual abuse = 30; no abuse = 19)	7 -17 years (Total, M = 14.10, SD = 2.3; Abuse, M = 13.49, SD = 2.3; No abuse, M = 15.28, SD = 1.6)	AMT (no. of OGM, not containing at least one specific detail)	Physical and sexual abuse	Abuse is not associated with OGM (but is in interaction with depression).	No
Valentino et al. (2009)	192 (Sexual and physical abuse = 67%; neglected = 56%; non-maltreated = 47%)	Non-clinical (Sexual and physical abuse = 36; neglected = 34; non-maltreated = 115)	7 -13 years (total, M = 10.61, SD = 1.55; Sexual and physical abuse = M = 10.69, SD = 1.6; neglected = M = 10.78, SD = 1.7; non-maltreated = M = 10.51, SD = 1.5)	AMT (no. of OGM, not containing at least one specific detail)	Neglect, physical and sexual abuse	Abused children recall more OGMs than did the neglected children and the non-maltreated children.	Yes

AMT = autobiographical memory test; MDD = major depressive disorder; PR = partially remitted; PSY = psychiatric sample; prop = proportion, no. = number of; neg = negative

¹ Follow up study 2 not included as mean age above 18 years old.

² Autobiographical memory interview (Kopelman et al., 1989)

³ FDQ = Family Disagreements Questionnaire (FDQ: Salzinger, Feldman, Hammer, & Rosario, 1992)

*39% of sample failed to meet to full criteria for 1 of the 3 symptom clusters

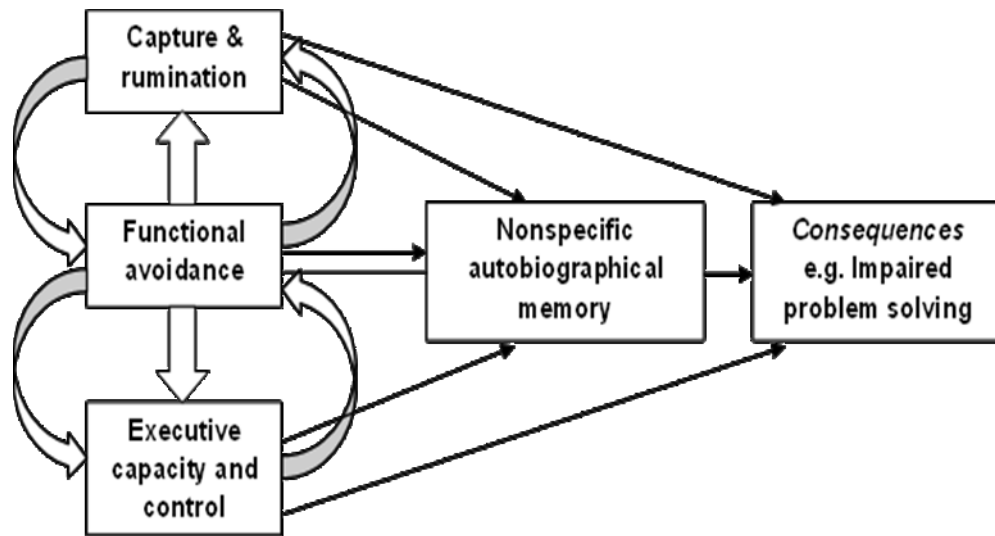


Figure 1: *The CaR-FA-X model. Three processes contributing to overgeneral memory—capture and rumination (CaR), functional avoidance (FA), and impaired executive capacity and control (X)—can each have effects on cognition and behaviour (e.g., problem solving), either independently or through their individual or combined effect on autobiographical memory (permission granted for reproduction of image from Professor J Mark G Williams).*

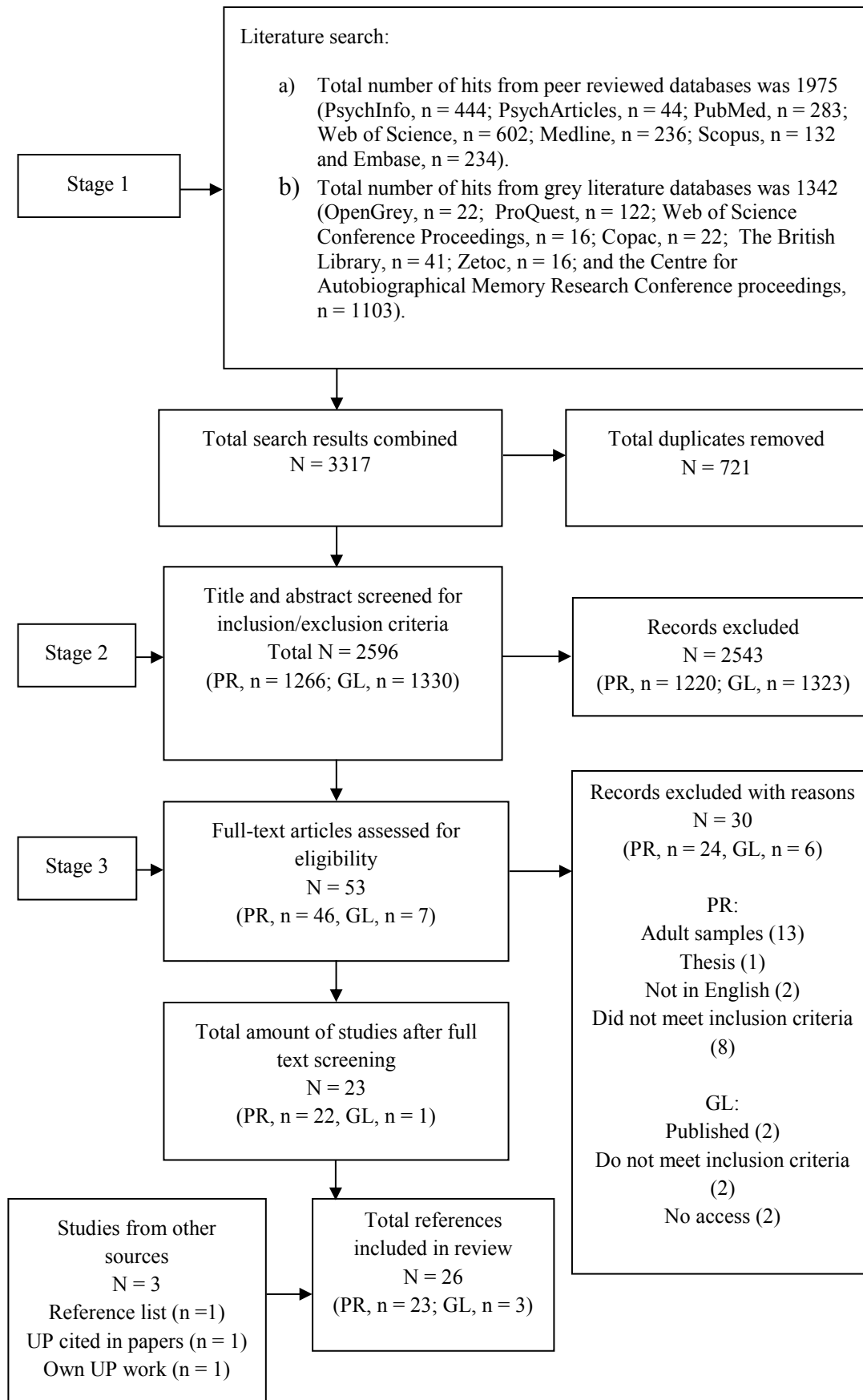


Figure 2. *Summary of database search*

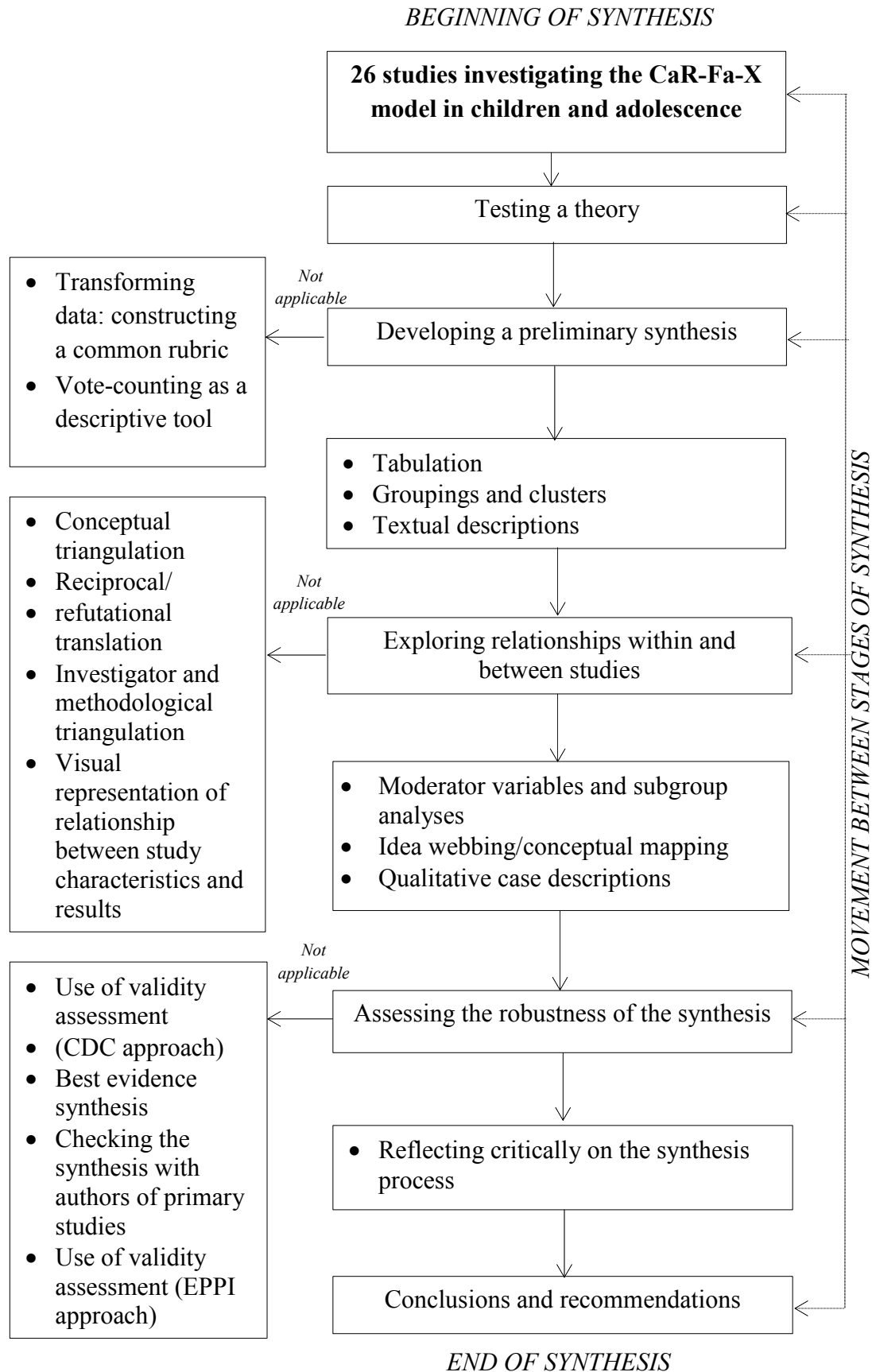


Figure 3: *Narrative synthesis*