Lost in distractors: Reduced Autobiographical Memory Specificity and dispersed activation spreading over distractors in working memory

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ABSTRACT

Studies on autobiographical memory retrieval highlight the prominence of rapid and direct access to a specific event memory. Because it has been believed that autobiographical memory retrieval mostly relies on an effortful generative process, there is little empirical evidence on the early stage of information processing that contributes to autobiographical memory specificity (AMS). Therefore, we investigated the associations between AMS and automatic activation of information stimulated by rapid presentation of emotional words. Study 1 involved a visual search task to assess activation of various distractors in working memory. Participants with reduced AMS showed a tendency to activate distractors that were not semantically associated with preceding cues. In Study 2, we manipulated the levels of AMS by using a computerized version of Memory Specificity Training (c-MeST) to observe the changes in the activation of distractors. Results showed that increases in AMS were associated with decreases in activation of cue-unassociated distractors. These findings suggest that reduced AMS can be characterized by dispersed activation spreading over semantically unassociated distractors in automatic information selection of working memory. Because we also found an association between depressive symptoms and AMS, the role of automatic information processing in the relation between reduced AMS and depression is discussed.

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Reduced Autobiographical Memory Specificity (AMS) is recognized as a hallmark of depressive cognition. Studies have shown that people with depression often fail to retrieve specific personal events, even when they are explicitly asked to do so (Dalgleish & Werner-Seidler, 2014; Williams et al., 2007); instead, those individuals tend to respond with overgeneral aspects of memories, which are often summaries and categories of similar events and experiences. Typically, reduced AMS is measured by a cued-recall task, the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986), in which respondents are asked to describe memories of past events in response to emotional cue words (e.g., happy, sad). A number of studies have suggested that reduced AMS is associated with (a) concurrent levels of depressive symptoms, (b) future increases in depressive symptoms, and (c) poor prognosis after a treatment for depression (Brittlebank, Scott, Williams, & Ferrier, 1993; Peeters, Wessel, Merckelbach, & Boon-Vermeeren, 2002; Raes et al., 2006; for reviews, see; Sumner, Griffith, &

Mineka, 2010; Van Vreeswijk & De Wilde, 2004). These findings unequivocally converge to suggest that reduced AMS is a cognitive vulnerability factor of depression, which is considered as a target of clinical interventions and treatments (Raes, Williams, & Hermans, 2009).

Despite the considerable evidence accumulated over the past several decades, there still remain unanswered questions regarding the cognitive processes leading to the successful (and unsuccessful) retrieval of specific memories. Although recent studies have suggested that reduced AMS is associated with general impairment in executive control (Dalgleish et al., 2007; Raes, Verstraeten, Bijttebier, Vasey, & Dalgleish, 2010; Smets, Wessel, & Raes, 2014), limited empirical evidence is available on the way information is processed during autobiographical memory retrieval. More specifically, it is still unclear what materials are selected and activated automatically or spontaneously during specific memory retrieval, and what (dys)functions in such cognitive mechanisms contribute to reduced AMS. Furthermore, it is also important to elucidate the consequences of changes in AMS in terms of the relevant rapid and automatic cognitive processes. In their seminal study, Raes et al.

(2009) developed a specific training protocol to improve reduced AMS, which has been demonstrated to be effective in reducing depressive symptoms in a randomized controlled trial (Neshat-Doost et al., 2013). Such a systematic manipulation of AMS is quite useful not only for clinical interventions, but also for speculating temporal and/or causal relationships between particular styles of cognitive processing (i.e., reduced AMS) and putative outcomes of attention and affect regulation systems (cf. Hertel & Mathews, 2011; Koster, Fox, & MacLeod, 2009). Therefore, we aimed to reveal the cognitive mechanisms underlying reduced AMS and its association with depressive symptoms by using a cross-sectional (Study 1) and a training-based experiment (Study 2).

Theoretical and empirical studies have suggested two possible pathways, namely generative and direct retrieval, to access specific and concrete information in one's personal memory network. One influential model of autobiographical memory, the Self-Memory System (SMS; Conway & Pleydell-Pearce, 2000) explains that reduced AMS is a consequence of truncation in generative memory search (Williams et al., 2007). In this model, autobiographical memory search is assumed to be a hierarchically organized "top-down" controlled process. Autobiographical memory is considered as a multi-layered system, with the top layers representing categoric and generic descriptors pertaining to conceptual summaries of experiences, and with the bottom layers containing more specific and concrete information (e.g., sensory perceptual details) of unique events. The model proposes that generative search starts with rapid activations of the top-level generic descriptors, which can be used for further elaborative and iterative searches for event-specific information, that is, a specific memory. Therefore, if people truncate their generative memory search at the top generic levels, only general descriptive information (or overgeneral memories) would be activated and available as an output response (Williams et al., 2007).

At the same time, it has also been proposed that specific memory retrieval requires inhibition of unneeded categorical descriptors during a memory search (Williams, Stiles, & Shapiro, 1999), and failure to inhibit such "task-irrelevant" representations leads to overgeneral memory responses (Dalgleish et al., 2007; for a review, see; Sumner, 2012). In a series of experiments, Dalgleish et al. (2007) showed that impaired executive function mediates the relationship between depressed mood and reduced AMS. Their findings highlight the importance of maintaining a task set (i.e., a memory response has to be specific) during the AMT itself (Yanes, Roberts, & Carlos, 2008) and inhibiting inappropriate response candidates (i.e., overgeneral memories) when generating a memory response (Barnhofer, de Jong-Meyer, Kleinpaß, & Nikesch, 2002; Dalgleish et al., 2007). Indeed, more recent studies have provided further evidence on this impoverished-inhibition hypothesis, showing that reduced AMS is associated with impaired inhibitory control measured by a questionnaire and various experimental paradigms (Piolino et al., 2010; Raes et al., 2010; Smets et al., 2014).

Although generative search was believed to be the dominant strategy in autobiographical memory retrieval (Haque & Conway, 2001), recent studies have proposed that direct retrieval, wherein memories are recalled without a preceding attempt at retrieval (cf. Berntsen, 2010), is more commonly used than previously suggested. The prevalence of direct retrieval is estimated around 50%, even in a laboratory-controlled memory task that requires intentional remembering in response to generic and emotional cue words (Harris, O'Connor, & Sutton, 2015; Uzer, 2016; Uzer, Lee, & Brown, 2012). Compared with generative retrieval, direct retrieval tends to be faster to recall a specific memory (2–4 s in Uzer et al., 2012), and to require less executive resources as it does not involve elaborative memory search processes (Addis, Knapp,

Roberts, & Schacter, 2012; cf.; Williams et al., 2006). These studies clearly show that a specific memory can be directly accessed without a search effort (Jeunehomme & D'Argembeau, 2016). In other words, rapid and automatic activation of information could play a critical role even in autobiographical memory search, which has been mainly discussed in a framework of the top-down generative search process (e.g., Conway & Pleydell-Pearce, 2000; Williams et al., 2007).

Another important implication from studies on direct retrieval is that a generative search strategy can be seen as a "back-up" process that is used when people cannot directly access an appropriate specific memory (Uzer et al., 2012). It is assumed that if people fail to access a specific representation of a past event in response to an experimenter-provided cue word, they recursively try to generate a secondary internal cue (or set of cues) that may be linked to an event memory (Norman & Bobrow, 1979; Williams & Hollan, 1981). Uzer (2016) also pointed out that abstract-level cues (e.g., emotions and superordinate categories of similar events) are less effective than concrete ones in accessing specific event memories, because they do not directly refer to an activity, place, and person, which are representative features of a specific memory. In such "false start" cases, wherein people find that the search query does not contain one of the target items, the memory query would be redefined and reformulated into an elaborated description (Reiser, Black, & Abelson, 1985). In light of these findings and arguments, it can be hypothesized that initial activation of information after seeing a cue word should be a primary factor to determine successful retrieval of a specific memory. If people can activate appropriate information that is closely associated with a specific event memory, the retrieval process can be "direct," which requires no control resources for generative search. However, if people are trapped in a task-irrelevant representation, the back-up (or generative search) process should be triggered, which would lead to longer response times and requires more cognitive efforts, and in the worst case, results in truncation of memory search (Williams et al., 2007).

To examine the role of relatively early stage information processing in autobiographical memory retrieval, we investigated selective attention or activation of particular types of information that is configured by presentation of emotional cue words. In Study 1, we designed a laboratory experiment to capture how people with reduced AMS spread activation in working memory to task-relevant and task-irrelevant information upon a rapid cue presentation. In Study 2, we employed cognitive training, Memory Specificity Training (MeST; Raes et al., 2009), to induce changes in AMS and to observe the possible influences on the cue-induced cognitive configuration. When doing so, we implemented the MeST into a computerized program. Such computerization not only provides rigorous control to eliminate possible contaminations by unexpected mechanisms (e.g., interpersonal interactions between therapists and patients), but also opens up a new avenue of a bias-modification approach that specifically focuses on the experimental and systematic manipulation of AMS. Another important research question is whether such modulation in memory and attention is associated with depressive symptoms. Because reduced AMS has been recognized as a vulnerability factor of depression, improvement in AMS and attentional functioning should be accompanied by reduction in depressive symptoms.

1. Study 1

In Study 1, we designed a laboratory experiment to examine spreading activation of cue-associated information upon presentation of an emotional cue. Although attention and activation of information are influenced by various internal and external factors,