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BRIEF REPORT

Misremembrance of things past: Depression is associated with difficulties in the recollection of both specific and categoric autobiographical memories

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Abstract

Impaired retrieval of specific, autobiographical memories of personally experienced events is a key characteristic of major depressive disorder (MDD). However, there are findings in subclinical samples which suggest that the reduced specificity phenomenon may be a reflection of a broader impairment in the deliberate retrieval of all autobiographical memory types. This experiment explored this possibility by requiring individuals with MDD (N=68) to complete a cued-recall task which required retrieval of specific memories to a block of cues, retrieval of categoric, general memories to a block of cues, and to alternate between retrieval of specific and general memories for a block of cues. Results demonstrated that relative to never-depressed controls, individuals with MDD experience reduced recall of both specific, single incident memories (d=0.48) and general memories (d=1.00), along with reduced flexibility in alternating between specific and general memories (d=0.90), a skill vital to restraining negative beliefs. Findings indicate that the flexibility of autobiographical retrieval is important for mental health and support further development of autobiographical memory-based interventions which target a range of retrieval deficits.

Autobiographical memory plays a fundamental role in daily cognition. We draw upon autobiographical memory hundreds of times a day to facilitate problem solving (Jing, Madore, & Schacter, 2016), to imagine and make plans for our future (Jing, Madore, & Schacter, 2017), and to facilitate shared relationship discourse (Beike, Brandon, & Cole, 2016). Disruption to autobiographical memory retrieval therefore, understandably, has a detrimental effect on daily functioning. Retrieval of an autobiographical memory requires successful navigation within a complex, multi-level autobiographical memory store. Models of autobiographical memory propose that autobiographical information is stored hierarchically, with categoric generalisations which summarise similar experiences (e.g., going to school) accessible at the top of the hierarchy and information regarding contextual detail of specific, single events (e.g., my final year History exam) stored at the bottom of the hierarchy (Conway & Pleydell-Pearce, 2000). This allows memories to be retrieved at different levels of granularity from general summaries to more detailed single event memories, and both of these memory types are important in daily functioning. Generalised memories help to form the basis from which we make judgements about ourselves and the world (Klein, Cosmides, Tooby, & Chance, 2002), and provide a heuristic for planning future events (Williams et al., 2007), while specific memories help us to cognitively reappraise difficult situations, solve problems and populate the details of future plans, by providing detailed information about what has worked in the past (Jing et al., 2016).

There is consistent evidence that targeted retrieval of autobiographical memories is impaired in mental health problems such as depression. In particular, there is prolific evidence that depressed individuals experience difficulties when trying to recall specific memories. A widely-used evaluation of an individual's profile of autobiographical recollection is the Autobiographical Memory Test (AMT) – a series of cue words of negative, positive, or neutral valence to which participants are asked to recollect specific personal

memories and where the dependent variable of interest is the relative proportion of specific (versus general) memories successfully retrieved (Williams & Broadbent, 1986). On the AMT, depressed individuals consistently retrieve a lower number of specific memories than healthy controls (Williams et al., 2007). Importantly, this reduced specificity does not appear to be simply an epiphenomenon of the depressed state, but rather independently predicts depressive prognosis (Sumner, Mineka, & Griffith, 2013), purportedly through reducing the aforementioned daily cognitive skills which rely upon recall of specific memories (e.g., cognitive reappraisal, problem solving). Targeting specific memory recall has thereby been investigated as a potential therapeutic intervention for depression (e.g., Memory Specificity Training; Raes, Williams, & Hermans, 2009), with evidence of significant treatment effects which are comparable in size to other evidence-based interventions (for review see Hitchcock, Werner-Seidler, Blackwell, & Dalgleish, 2017; Werner-Seidler et al., 2018).

While difficulty retrieving specific memories is a well-established characteristic of depression, there is evidence from analogue studies to suggest that the phenomenon may reflect a broader impairment in the ability to successfully navigate the autobiographical memory store, rather than a specificity issue *per se*. Dalgleish et al. (2007) demonstrated that subclinical symptoms of depression were associated not only with reduced recall of specific memories on the AMT, but also with a reduced ability to recall generalised memories when explicitly instructed to do so on a Reversed Instructions version of the AMT. Building upon this work, Dritschel and colleagues (2014) sought to assess flexibility in autobiographical retrieval using an Alternating Instructions version of the AMT (AMT-AI) which combines the standard AMT with the Reversed Instruction protocol and requires individuals to alternate between retrieval of specific and general memories. Dritschel et al. found that reduction in the ability to alternate between retrieval of specific and general memories was associated with higher subclinical symptoms of depression. These analogue findings suggest that clinical

depression may not simply be characterised by reduced memory specificity, but potentially also with reduced ability to deliberately retrieve general memories, and to flexibly move between retrieval of different autobiographical memory types.

This study therefore extends the work on memory inflexibility and depressed mood (Dalgleish et al., 2007; Dritschel et al., 2014) for the first time to a clinical sample. In particular, we aimed to determine whether the difficulties with the flexible retrieval of autobiographical memories (Dritschel et al., 2014) and with categoric memory retrieval (Dalgleish et al., 2007) found in those with subclinical levels of depression are also evident in those with clinical depression. Given the ongoing development of autobiographical memory-based interventions (Hitchcock, Werner-Seidler, et al., 2017) which seek to translate cognitive science into novel, precision-based intervention approaches (cf National Institute for Mental Health's Research Domain Criteria; Insel et al., 2010), it is important to determine that the targeted cognitive processes is an accurate operationalisation of the underlying mechanism. An imprecise definition of the mechanism of change will compromise the potential efficacy of any mechanism-driven, process-focussed intervention.

Our specific hypotheses were that, on the Alternating Instructions Autobiographical Memory Test (AMT-AI; Dritschel et al., 2014), individuals with a diagnosis of Major Depressive Disorder (MDD), currently in episode, relative to never-depressed control participants, would demonstrate a broad deficit in the targeted retrieval of both specific (Williams et al., 2007), and categoric memories (Dalgleish et al., 2007), when presented in separate blocks and also when mixed in an alternating block. We further hypothesised that there would be an added retrieval cost for depressed individuals when asked to flexibly switch between specific and categoric recall in the alternating block, relative to either recall type alone in the separate blocks (Dritschel et al., 2014).

Method

Participants

Based on the moderate effect size for the relationship ($d = 0.60$, directional $\alpha = .05$) between AMT-AI performance and depressive symptoms observed by Dritschel et al. (2014), data were collected from 34 healthy community volunteers with no previous history of psychiatric disturbance who were registered on our department's panel of volunteers (control group), and 34 (depressed group) individuals with a diagnosis of Major Depressive Disorder (MDD), experiencing a current Major Depressive Episode (MDE). The depressed group were also invited to participate in a trial of an autobiographical memory-based intervention reported elsewhere (see preprint; Hitchcock et al., 2018). As all consented to participate, data reported on in this paper also contributed to baseline data for the trial. Depressed individuals were recruited from our department's panel of volunteers with a history of depression. Diagnostic status was determined by trained research staff using the Structured Clinical Interview for DSM Disorders (SCID; First et al., 2001), under the supervision of a clinical psychologist (Hitchcock) who also second-rated each SCID. Discrepancies were resolved via discussion and this resulted in 100% agreement on diagnostic status for primary and comorbid disorders. Both panels of volunteers comprise individuals who have responded to print and online advertisements requesting volunteers to participate in scientific research at the MRC Cognition and Brain Sciences Unit.

For both groups, exclusion criteria were intellectual disability, traumatic brain injury, or current substance/alcohol use disorder. For healthy control participants, exclusion criteria also comprised presence of a current or prior diagnosis of a DSM psychiatric disorder and/or a score of 13 or more (above the cut-off for the mild range) on the Beck Depression Inventory II (BDI-II; Beck et al., 1996). Two potential control participants were excluded on

this basis. Groups were matched on age, gender, and highest level of received education (see Results).

Materials

Autobiographical Memory Test- Alternating Instructions (AMT-AI; Dritschel et al., 2014). The AMT-AI is an adaption of the original Autobiographical Memory Test (AMT; Williams & Broadbent, 1986). The AMT measures the ability to deliberately retrieve specific event memories in response to a series of cue words of positive, negative, or neutral emotional valence. The AMT-AI extends the original AMT by requiring individuals to recall specific autobiographical memories to a series of six cue-words, to recall categoric autobiographical memories to a series of six cue-words (as required in the Reversed version of the AMT [AMT-R]; Dalgleish et al., 2007), and to alternate between recall of specific and categoric memories for twelve cue-words. The order of these specific (AMT-S), categoric (AMT-R), and alternating (AMT-A) blocks was randomized between participants. Two lists of cue-words were randomized between participants – the original list used by Dritschel et al. (2014) and a second list we created to match the number of positive (n = 8), negative (n = 8), and neutral words (n = 8), and cue frequency in the English language (Wilson, 1988), $F<1$. All cue-words were taken from the MRC Psycholinguistic Database (Wilson, 1988) and were randomized between blocks. Before completing test trials, participants were given four practice trials (two for specific memories and two for categoric memories), and feedback was provided in response to incorrect answers.

Task instructions were presented on a computer, and following an instruction to recall either a specific or categoric memory, participants were given one minute to press a computer key to indicate that they had a memory in mind. Participants then reported their memory aloud, and responses were audio-recorded and later coded as to whether they were specific, categoric, extended (i.e., event lasting longer than one day), or repeated (i.e., a memory that

had been previously reported) memories, a semantic associate (i.e., information related to the cue which is not a memory), or an omission (i.e., could not think of a memory). Ten percent of audio recordings were coded by a second rater. There was good (Cicchetti, 1994) inter-rater reliability – intraclass correlation coefficient = .75. Due to the uneven number of trials between blocks, we used proportions correct in each block as our dependent variable. The proportion of correct responses was calculated as the number of memories recalled in line with the instructions for that block, divided by the number of trials minus the number of omissions, as per Dritschel et al. (2014). Results remained the same when the number of omissions was not subtracted.

Executive control. We administered measures of executive control to ensure that groups were comparable on verbal executive abilities pertinent to AMT-AI performance. The FAS Verbal Fluency Task (VFT; Spreen & Strauss, 1998) was used to assess executive control over verbal information. Participants were given 60 seconds to generate words in a given category (animals, foods, or occupations) and a further 60 seconds to generate words beginning with a certain letter (F, A, S). We recorded the number of correctly identified words in each condition (incorrect responses are repeated words or proper nouns or words that did not fit the category/letter). The Digit Span task from the Weschler Adult Intelligence Scale (WAIS-IV; Weschler, 2014) was also administered to index working memory span.

Symptom measure. The BDI-II consists of 21 items that are used to assess depressive symptoms and severity over the past two weeks. The scale is valid and reliable. A score of 13 or below is within the Normal/Non-Clinical range, 14-19 reflects the Mild range, 17-29 reflects the Moderate range, and 30 and above reflects the Severe range of depression symptom severity (Beck et al., 1996).

Procedure

Ethical approval was obtained from the NHS National Research Ethics Committee (East of England, 11/H0305/1). After providing written informed consent, participants individually completed the AMT-AI, VFT, Digit Span, and BDI-II in a quiet testing room on a single occasion. All depressed participants had previously completed the SCID to assess MDD diagnosis and comorbidity, and both depressed and control participants completed the Mood Module of the SCID (to index history of depression and diagnostic status) during the testing session. Assessment sessions lasted 45-60 minutes, and participants were reimbursed at a rate of £6 per hour for their time, plus travel expenses.

Results

Sample characteristics

Descriptive statistics are presented in Table 1. The depressed and control groups were comparable on age, $t(66)=0.14$, $p=.89$, gender, $\chi^2(3)=2.68$, $p=.44$, and level of education, Fisher's Exact= 3.44, $p=.53$. Importantly, the groups were also matched on levels of verbal executive ability as indexed by scores on the Digit Span Test, $t(66)=1.21$, $p=.23$, and verbal fluency, $t(66)=0.15$, $p=.88$. Groups differed on depressive symptoms in the anticipated direction, $t(38.82)=12.69$, $p<.001$. The mean BDI-II score for the depressed group was on the lower end of the Severe range. The mean number of previous depressive episodes was 3.53 (SD= 1.74), with 9 of the depressed participants having experienced too many episodes to count the distinct number, as coded on the SCID. One depressed participant met criteria for diagnosis of current obsessive compulsive disorder, eight met criteria for current generalized anxiety disorder, and two met criteria for current posttraumatic stress disorder.

AMT-AI performance

A MANOVA examining the proportion of correct responses across the three conditions (AMT-S, AMT-A, AMT-R) (see Figure 1) with group as a between-subjects factor

demonstrated a significant multivariate effect of group, Wilk's Lambda = 0.75, $F(3, 64) =$ 6.98, $p < .001$. The planned follow-on univariate analyses revealed that, in line with our hypotheses, the depressed group demonstrated a lower proportion of correct responses than controls for the AMT-S, $F(1, 66)= 3.90$, $p= .05$, $d= 0.48$ [-0.02, 0.98], AMT-R, $F(1, 66)=$ 17.05, $p < .001$, $d= 1.00$ [0.48, 1.52], and AMT-A blocks, $F(1, 66)= 13.82$, $p < .001$, $d= 0.90$ [0.38, 1.42]. Our hypotheses were therefore supported[1].

To explore whether there was a performance cost for retrieving memories in the alternating condition, relative to the single memory type blocks (cf Dritschel et al., 2014), we compared the proportions of specific/categoric memories correctly recalled in the AMT-S/AMT-R blocks against the proportion of those memories recalled in the AMT-A block (see Figure 1). We completed two mixed ANOVAs (for Specific and Categoric memories, separately) with Block (single, alternating) as the within-subjects factor, and Group as a between-subjects factor. Again, significant effects of Group revealed that across block types, depressed participants demonstrated fewer correct responses than controls, Specific memories: $F(1, 66)= 6.45$, $p= .01$, $d= 0.62$ [0.12, 1.12]; Categoric memories: $F(1, 66)=$ 19.81, $p < .001$, $d =1.08$ [0.55, 1.61], but there was no significant effect of Block, nor any Block × Group interaction for either memory type, all Fs<1. There was therefore no support for an additional cost of alternating instructions on recall of either specific or categoric memories.

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[1] We completed a *post hoc* analysis to investigate whether there was any differential effect between groups for Specific versus Categorical recall. A mixed ANOVA with Block (AMT-S, AMT-R) as the within-subjects factor and Group as the between-subjects factor revealed the expected main effect of Group, $F(1, 66)= 12.40$, $p = .001$, $d =0.85$[0.34, 1.36], a significant effect of Block, $F(1, 66)= 10.55$, $p = .002$, $d =0.79$ [0.28, 1.30], and a significant Group by Block interaction, $F(1, 66)= 5.78$, $p = .02$, $d =0.58$ [0.08, 1.08]. Paired t-tests revealed that performance in the Control group was not significantly different across blocks, $t(33)= 0.63$, $p =.54$, but that the Depressed group performed significantly worse at retrieving Categoric memories than Specific Memories, $t(33)= 3.83$, $p =.001$.

Table 1. *Mean (standard deviation) sample characteristics by group.*

	Depressed (*n*= 34)	Controls (*n*= 34)
Age	33.97 (13.27)	33.50 (13.58)
Number of females	20	18
Percentage Caucasian	70.6	76.5
Education level	1;11;2;12;8	0;7;1;13;13
Verbal Fluency Task	19.96 (5.09)	19.12 (4.84)
Digit Span	18.65 (4.48)	19.94 (4.31)
BDI-II	29.50 (11.50)	3.38 (3.43)

Note. BDI-II= Beck Depression Inventory- Second edition (Beck et al., 1996); Education level= number completed Year 11; 6th form; diploma/additional training; undergraduate degree; postgraduate degree (UK system).
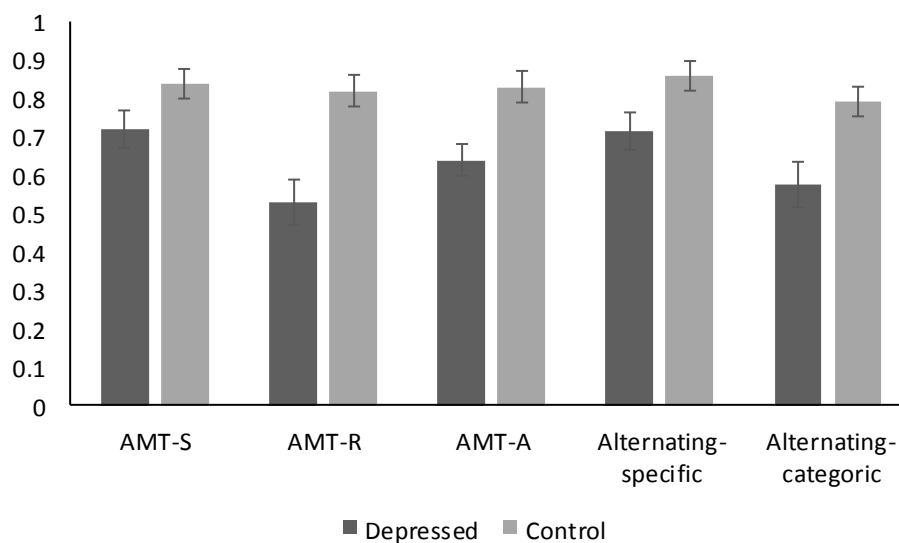
Figure 1. Mean (SE) proportions of memories correctly recalled in the Specific (AMT-S), Reversed (AMT-R) and Alternating (AMT-A) blocks, and for specific trials (Alternating-specific) and categoric trials (Alternating-categoric) in the Alternating block of the Autobiographical Memory Test-Alternating Instructions.

Discussion

The current findings demonstrated that relative to never-depressed control participants, individuals with a diagnosis of Major Depressive Disorder experienced difficulties with the intentional recollection of both specific and categoric memories, although there was no support for an additional performance cost in depression when participants had to rapidly switch between one memory type and another. Interestingly, larger effect sizes relative to controls were observed for deliberate recall of general memories (d=1.00) and the ability to alternate between specific and general memories (d=0.90) compared to the deliberate recall of specific memories (d=0.48). These findings are consistent with the notion that reduced memory specificity consistently observed in depressed samples is one component of an overall deficit in the ability to intentionally retrieve autobiographical memories of different types. This has implications for the conceptualization of the autobiographical memory difficulties driving depressive symptom change and the consequent translational development of emergent science-driven interventions.

There are a number of factors which may reduce the ability to successfully navigate the autobiographical memory store and correctly retrieve a predefined memory type as elucidated in the CaRFAX model (Williams et al., 2007). These include goal neglect during the retrieval process, and the retrieval search becoming hijacked by either the internal affective context in which retrieval occurs (Hitchcock, Golden, Werner-Seidler, Kuyken, & Dalgleish, 2018) or by self-relevant information that is activated during the search (Williams et al., 2007). Although further research is needed to explore the mechanisms impairing directed retrieval (for review of proposed mechanisms see Sumner, 2012), this pattern of results is unlikely to simply be a function of more domain-general cognitive performance difficulties associated with depression, as our depressed and comparison samples were matched in terms of performance on measures of working memory and executive fluency.

This study extends for the first time the evaluation of performance on the AMT-R (Dalgleish et al., 2007) and AMT-AI (Dritschel et al., 2014) to clinical depression. As discussed in the Introduction, successful navigation of autobiographical memory appears important in supporting a number of cognitive processes that are central to daily life. The generalized summaries provided by categoric memories guide efficient decision making (Klein et al., 2001; Cosmides & Tooby, 2000), while specific memories play an important role in problem solving (Jing et al., 2016) and facilitating social interaction (Beike et al., 2016) – everyday skills which are compromised during depression, subsequently driving functional impairment. Further, we recently demonstrated that interaction between generalisations and specific memories may serve to shape emotionally valenced self-evaluations (Hitchcock, Rees, & Dalgleish, 2017). Improving the ease with which depressed individuals can generate these different memory types on demand, and move between them, may therefore help to alleviate symptoms of depression.

Current autobiographical memory-based interventions have focussed on improving recall of specific memories, but our findings suggest that explicitly training improved recall of all memory types may more appropriately mitigate the autobiographical retrieval issues experienced by the clinically depressed. Indeed, there is evidence that intervention to improve the flexibility of memory retrieval may have a positive impact on symptoms of depression (e.g., Hitchcock et al., 2018, April 17; Hitchcock et al., 2016) and the current results support further development of such interventions.

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