

In Press, *Emotion*

Reduced specificity of emotional autobiographical memories following self-
regulation depletion

Hamid Taher Neshat-Doost

University of Isfahan and

Medical Research Council Cognition and Brain Sciences Unit

Tim Dalgleish

Ann-Marie Golden

Medical Research Council Cognition and Brain Sciences Unit

Abstract

The present study used a Color Stroop task, involving naming the ink colors of incongruous color words, to deplete self-regulation resources prior to retrieving a series of autobiographical memories to emotional and neutral cue words - the Autobiographical Memory Test (AMT). Control participants either read color words written in black ink or performed no task prior to the AMT. Difficulty accessing specific memories on the AMT has been shown to index key aspects of the onset and maintenance of depression and other emotional disorders.

Our hypothesis that depleted participants would retrieve fewer specific memories to cues on the AMT relative to controls was supported, even when levels of depressed and anxious mood, an index of clinical depression, post-traumatic stress, and verbal intelligence were covaried. The results indicate that self-regulation depletion via a neutral, unrelated task can impact on emotion-related autobiographical memory processes that have been shown to be dysfunctional in emotionally disordered populations.

Keywords: ego depletion, over-general memory, autobiographical memory specificity, self-regulation

Introduction

In this study we integrate two research domains: reduced specificity of emotion-related autobiographical memory from the abnormal psychology literature (Williams et al., 2007), and ego depletion from the social cognition literature (Muraven & Baumeister, 2000). Reduced memory specificity refers to a relative difficulty in accessing specific autobiographical memories when asked to do so, normally in response to emotional cue words, such that remembering instead comprises generic summaries of the past. Such reduced specificity is associated with a variety of emotional disorders, most notably depression and traumatic stress conditions (Williams et al., 2007). Ego depletion refers to the notion that self-regulation is a limited mental resource that becomes depleted following performance of tasks requiring such regulation. Consequently, performance of subsequent regulation-demanding activities is impaired. The proposal examined in the present study is that retrieval of specific autobiographical memories to cues is a self-regulation demanding task in that it requires the participant to over-ride impulses to generate inappropriately general summaries of the past (Dalgleish et al., 2007). Consequently, memory specificity should be compromised as a consequence of ego depletion in individuals who have previously completed a regulation-demanding task, relative to non-depleted individuals.

Reduced autobiographical memory specificity

When asked to recall specific autobiographical memories of events with a duration of less than a day in response to word cues, people sometimes produce overly general responses. For example, the cue "*holiday*" might prompt the generic recollection "*I enjoyed all of my holidays as a teenager*" instead of the more

Memory specificity and ego depletion

appropriate specific response "I remember the day that we went to Disneyland".

Reduced memory specificity has been found to be a characteristic of performance on this cue word task (the Autobiographical Memory Test [AMT]) in a number of clinical groups, including depression (e.g. Brittlebank, Scott, Williams, & Ferrier, 1993), complicated grief (Golden, Dalgleish, & Mackintosh, 2007), Posttraumatic Stress Disorder (PTSD) (e.g. McNally, Lasko, Macklin, & Pitman, 1995), and eating disorders (e.g. Dalgleish et al., 2003). Furthermore, reduced memory specificity has been found to be associated with levels of sub-clinical depressed mood in both naturalistic (Ramponi, Barnard, & Nimmo-Smith, 2004), and mood induction studies (e.g. Yeung, Dalgleish, Golden, & Schartau, 2006). Reduced memory specificity appears to index one or more fundamental cognitive processes linked to the onset, maintenance and recovery from a variety of clinical and sub-clinical states. For example, Brittlebank et al. (1993) showed that reduced specificity predicted later clinical recovery in individuals with Major Depressive Disorder (MDD), *over and above* initial levels of depressive symptoms.

Recently, it has been suggested that reduced memory specificity may in part be a function of relatively diminished working memory capacity (WMC), or executive attention (Dalgleish et al., 2007; Williams et al., 2007). WMC refers to the ability to attend to, and implement, task goals in ways that require the overriding of primed or prepotent task-irrelevant responses (see Barrett et al., 2004). The WMC hypothesis of reduced memory specificity proposes that capacity is required when performing the AMT in order to maintain the search through the autobiographical memory database (Conway & Pleydell-Pearce, 2000) for a specific memory in the face of candidate memories that have come to mind during the search which are not appropriately specific (i.e., they are 'over-general') and that must therefore be set aside. This is, of

Memory specificity and ego depletion

course, likely to occur more clearly for some word cues on the AMT (i.e. those with more over-general autobiographical associates) than for others (see Dalgleish et al., 2003). In this analysis, diminished capacity would increase the likelihood that these inappropriate candidate memories could not be set aside and will be mistakenly be offered as task responses, in lieu of the desired specific memories.

Clearly then, anything that compromises available WMC is likely to lead to relatively reduced specificity on the AMT, whether it be individual differences in WMC in the healthy population, or being in an emotionally disturbed state such as depression, as in the studies reviewed above. In support of these arguments, research has shown that reduced WMC is associated with reduced memory specificity on the AMT, independent of depressed mood, and also that WMC mediates the relationship between depressed mood and specificity (Dalgleish et al., 2007).

Ego depletion

Self-regulation can be defined as any effort to override or alter one's thoughts, emotions, motivations or behaviours (e.g. Metcalfe & Mischel, 1999). The theory of ego depletion proposes that the capacity for self-regulation fluctuates within an individual across time and context, operating like a muscle or an energy resource that becomes depleted after use and is replenished after a refractory period of rest (Muraven & Baumeister, 2000). According to this theory, engaging in acts of effortful self-regulation compromises capacity for further self-regulation even in seemingly unrelated domains of activity. For example, in a prototypical study Baumeister, Bratslavsky, Muraven and Tice (1998) showed that participants who had to exercise self-regulation in order to resist eating chocolates while eating radishes, when compared with participants presented with radishes alone, quit more quickly on a later task requiring them to persist in trying to solve what were in fact unsolvable puzzles.

Memory specificity and ego depletion

Subsequent research has revealed that people in such depleted states are more likely to consume excessive amounts of alcohol (Muraven, Collins, & Nienhaus, 2002), perform worse on effortful (but not automatic) intellectual tasks (Schmeichel, Vohs, & Baumeister, 2003), are more likely to violate their diets (Vohs & Heatherton, 2000), are less able to cope with thoughts about death (Gailliot, Schmeichel, & Baumeister, 2006), and are less able to control their aggressive impulses (DeWall, Baumeister, Stillman, & Gailliot, 2007), as compared to people whose self-regulatory resources have not been depleted.

As one might expect, self-regulation capacity and WMC are broadly overlapping constructs and there is evidence that WMC can also become depleted through use. For example, in four studies Schmeichel (2007) showed that participants initially performing one of a range of WMC-demanding tasks exhibited depletion effects such that performance on subsequent WMC-demanding tasks was impaired, relative to control participants who had not performed the initial tasks.

The current study

As it seems that retrieval of specific autobiographical memories on the AMT is a function of WMC, and that WMC is a construct that overlaps significantly with self-regulation capacity, and can thus be temporarily depleted through use, a clear empirical prediction emerges: that individuals whose self-regulation capacity has been depleted on a prior self-regulation task should produce fewer specific memories on the AMT than individuals who have either performed a prior non-depleting task, or performed no prior task.

To examine this prediction, we depleted self-regulation resources using the Color Stroop paradigm (Stroop, 1935) – a task shown to deplete self-regulation capacity in previous research on ego depletion (e.g., DeWall et al., 2007) as well as

Memory specificity and ego depletion

being identified as a task that places significant demands on WMC such that those lower in WMC experience more interference (Kane & Engle, 2003). The Color Stroop requires participants to overcome their over-learned inclination to read a word in order that they can instead say the color of the ink in which it is written. Crucially, the words participants are trying not to read are the names of colors that are different to the ink colors that participants are trying to say out loud (e.g. the word *yellow* written in blue ink with the requirement to say “blue” and to avoid saying “yellow”). DeWall et al. (2007) showed that individuals whose self-regulation capacity had been depleted by such a Color Stroop task were more likely to respond aggressively to provocation than non-depleted controls.

We also had two control conditions. In the first, participants completed no other task prior to the AMT (No Stroop condition). However, in line with previous studies (e.g. DeWall et al., 2007) we also wanted to control for task non-specific factors such as having to process a particular set of words, having to perform a repetitive task with potential effects on mood and tiredness, and so on. Consequently, in a second control condition participants were presented with the same words as in the Color Stroop but this time written in black ink (the Control Stroop task). Their task was simply to read the words aloud (DeWall et al., 2007). Following these manipulations all participants completed the AMT.

Our predictions were that those participants completing the Color Stroop task would subsequently retrieve fewer specific memories on the AMT than either those performing no task or those performing the Control Stroop task. We anticipated no significant differences in numbers of specific memories between the latter two groups.

Method

Participants

Fifty community volunteer participants were recruited from the Cognition and Brain Sciences Unit panel. Inclusion criteria were: self-reported normal colour vision and reading ability; English as a first language; and falling between the ages of 18 and 30. Participants were randomly allocated to three experimental conditions (Color Stroop, $n = 18$; Control Stroop, $n = 14$; and No Stroop, $n = 18$).

Measures

The Stroop task (Stroop, 1935)

The two Stroop tasks were as described in the Introduction. In the Color Stroop the ink colors (RED, GREEN, BLUE and YELLOW) were always incongruent to the semantic meaning of the same four color words used as stimuli. In the Control Stroop participants simply had to read aloud the same four color words which were all now printed in black ink. The Stroop tasks were presented on 42 x 59 cm cards with 120 words (trials) per card. The cards in each condition were identical to each other, except for ink color. Each condition contained equivalent numbers of color words (30 of each color). In the Color Stroop condition, each color word was written 10 times in each incongruent ink color. Participants performed their respective task for 6 ½ minutes in line with previous studies using the Stroop task to examine self-regulation depletion (DeWall, personal communication). The number of trials completed within this time, and the error rates, for each participant were recorded.

Autobiographical Memory Task (AMT)

The AMT used was almost identical to that used by Dalgleish et al. (2007; Experiment 3), with the exception that in the present version participants were given 30 seconds as opposed to 1 minute to generate a specific memory – a standard

Memory specificity and ego depletion

variation in this literature (Williams et al., 2007). Participants were presented with 15 cue words consisting of 5 positive words (e.g., *holiday*), 5 negative words (e.g., *bereavement*), and 5 neutral words (e.g., *adolescence*). Participants were given 30 seconds in each case to retrieve a specific autobiographical memory - a specific time and place when something happened to them. Participants were told that the memory they recalled could be something that happened recently or a long time ago, that it may be an important or trivial event, but that the memory should be of something that happened *at a particular time on a particular day*. Examples of acceptable and unacceptable responses were given. The recall instructions were printed out for the participants to read. Cue words were presented on 21 x 30cm laminated cards and were written in black ink in capital letters 3.5 cm high. Words were presented in a separate random order for each participant. Three practice cues were given (*absence, gigantic, grass*).

Generated memories were tape-recorded for coding (Williams et al., 2007). Specific memories were defined as events that lasted for a *day or less*. Non-specific memories included *extended memories* (events that lasted for longer periods of time), and *categoric memories* (events that occurred repeatedly over a period of time). If the participants failed to recall a memory within the time limit, or talked about things which were not memories (e.g. an opinion that is associated with the cue), their responses were classed as '*no memories*'. If either the type of memory that the participants recalled was unclear, or they retrieved the same memory to more than one cue, or they offered responses that related to future events, they were prompted with the words '*What is the memory that you are thinking of there?*' or '*Can you tell me a bit more about that memory?*'. For the present study, analyses focus on numbers of *specific* memories, in other words, to the total number of specific memories generated

Memory specificity and ego depletion

to the entire set of words, in line with previous work on WMC and the AMT (Dalgleish et al., 2007; Dalgleish, Rolfe, Golden, Dunn, & Barnard, 2008). However, corroboratory analyses for numbers of categoric memories are also reported. Inter-rater agreement for the coding of specific memories between AG and HD on 20% of the retrieved memories ($n = 150$) indicated excellent reliability, $\kappa = .91$.

Procedure

Participants were tested individually in a quiet testing environment.

Participants in the Stroop conditions first completed their respective Stroop tasks while the No Stroop participants did nothing. The Stroop participants then rated how difficult their Stroop task had been, and all participants completed the ratings of mood and tiredness, on scales ranging from 0 (*not at all*) to 100 (*extremely*) (DeWall., et al., 2007). Participants were then assessed on measures of variables known to influence memory specificity: the National Adult Reading Test, a widely-used estimate of verbal IQ (Nelson, 1991); Questions A1 and A2 from the Structured Clinical Interview for the DSM-IV (SCID) (First, Spitzer, Gibbon, & Williams, 1997) - a sensitive and widely used screen for the presence of current and/or past MDD (Whooley, Avins, Miranda, & Browner, 1997); the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) - a commonly used measure of depression symptoms, the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) - a measure of state and trait anxiety; and the Impact of Event Scale-Revised (IES-R; Weiss & Marmar, 1997) - a widely-used measure of post-traumatic stress which individuals were asked to complete with respect to the event in their lives that currently causes them the greatest distress.

Results

Participant characteristics

Participant characteristics are presented in Table 1. Group differences were examined using univariate ANOVA with post hoc Least Significant Difference (LSD) tests. As can be seen, there were no significant differences across groups on any variable indicating that randomization had been largely successful in creating matched groups. However, there was a near significant trend for BDI-II scores to differ across groups, with LSD tests revealing that the Color Stroop group scored significantly higher than the other two groups, $P_s < .05$, which did not differ from one another, $P = .92$. In subsequent analyses we therefore controlled for depressed mood on the BDI-II.

Stroop task performance

Table 1 also records the relevant data from the Stroop tasks. As can be seen, the Color Stroop group completed fewer trials on the task, made more errors, and reported the task to be more difficult than the Control Stroop group, as expected. All three groups were comparable on the mood and mental state variables prior to the AMT.

Autobiographical Memory Task Performance

Figure 1 shows the total numbers of specific memories retrieved across the three conditions (Color Stroop, Control Stroop, No Stroop). One way ANOVA revealed the hypothesized significant effect of Condition, $F(2,47) = 7.29$, $P < .01$, $\eta_p^2 = .24$. Post hoc LSD tests indicated that the Color Stroop group retrieved significantly fewer specific memories than both the Control Stroop, $P = .02$, Cohen's $d = .84$, and No Stroop, $P = .001$, $d = 1.14$, groups, who did not differ significantly from each other, $P = .32$, in line with our hypotheses.

Memory specificity and ego depletion

As noted, we were concerned that the Color Stroop group had scored higher on self-reported depression at study entry than the other two groups. Given that higher levels of depression are associated with lower levels of specific memories on the AMT (Williams et al., 2007) we wanted to examine the potential contribution of these group differences to our data. We examined this issue in two ways. First, we repeated the previous ANOVA, this time with BDI-II scores as a covariate. This again revealed a significant effect of Condition, $F(2,46) = 7.66, P < .01, \eta_p^2 = .25$, for numbers of specific memories retrieved, with a marginally higher effect size than the original analysis. Paired contrasts indicated that the Color Stroop group again retrieved significantly fewer memories than both the Control Stroop, $P = .01$, and No Stroop, $P < .001$, groups, who did not differ significantly from each other, $P = .32$, in line with our hypotheses.

Because research has shown that symptoms of post-traumatic stress and intelligence can also be associated with numbers of specific memories generated on the AMT we repeated this ANCOVA with IES-R scores and NART errors, as well as indices of current and/or past MDD, covaried, along with the BDI-II scores, even though the former 4 measures did not differ significantly across the three groups. The significant effect of Condition remained, $F(2, 42) = 6.02, P < .005, \eta_p^2 = .22$.¹

We also repeated the key analyses reported above this time using numbers of categoric memories as the dependent variable, as a number of studies in the AMT literature have used this index (Williams et al., 2007). There remained a significant effect of Condition, $F(1,47) = 3.63, P < .05, \eta_p^2 = .13$, with the Color Stroop group generating significantly more categoric memories ($M = 1.67, SD = 1.75$) than both the Control Stroop ($M = .57, SD = 1.16$), $P = .02, d = .74$, and the No Stroop ($M = .67, SD$

Memory specificity and ego depletion

=.84) groups, $P = .03$, $d = .73$. Again, if anything, this effect was strengthened by the inclusion of BDI-II scores as a covariate, $F(1,46) = 4.75$, $P = .01$, $\eta_p^2 = .17$.²

Discussion

We examined whether relatively reduced autobiographical memory specificity on the AMT could be induced by depleting participants' self-regulation resources using a Color Stroop task. Control participants were either presented with the same color words in black ink to read aloud (the Control Stroop condition) or performed no task, prior to the AMT.

In line with predictions, the Color Stroop group retrieved fewer specific memories on the AMT than the two control groups who did not differ from each other. It seems unlikely that this finding was a function of depressed mood as it remained significant once levels of depression on the BDI-II (as well as indices of past and current MDD) were covaried and when groups were matched on depression levels. It was also not the case that participants in the Color Stroop group were simply generating fewer memories overall on the AMT, as they in fact produced *more* categoric (over-general) memories than the other two groups. Finally, the effect does not seem to be dependent on general mood or mental state factors as these were not significantly different across the three conditions.

The present data therefore support the view that producing suitably specific memories on the AMT depends on having the requisite self-regulation resources available, presumably to inhibit the generation of categoric responses which are primed by a proportion of the emotional cue words (Dagleish et al., 2007). The data also strongly suggest that memory specificity on the AMT can vary as a result of temporary depletion in self-regulation resources. These findings have a number of implications.

Memory specificity and ego depletion

First, they suggest that the tendency to involuntarily frame the autobiographical past in ‘over-general’ terms may be rendered more or less likely in the day-to-day as a result of the waxing and waning of self-regulatory resources. This has particular consequences for emotional disorders such as depression where ‘over-general’ representations of the self (self-schemas), including those concerning the autobiographical past, are generally very negative in content. Any increased tendency to process incoming information in terms of these negative categorical representations is therefore likely to have emotionally toxic consequences.

Secondly, the data suggest that self-regulation depletion as a function of affectively neutral tasks (in this case the Color Stroop) can have downstream consequences for the processing of emotional information in potentially dysfunctional ways. This implies that individuals with emotional difficulties are likely to suffer from a compromised ability to self-regulate thoughts, feelings, memories and behaviors associated with their distress even after performance of ostensibly unrelated regulation-demanding tasks. However, the data further suggest that training individuals in self-regulation within a therapeutic context would have potential clinical benefits in resisting the influence of depletion effects.

Thirdly, the data have implications for the practice of research on cognitive-affective interactions (Vasey, Dalgleish, & Silverman, 2003) as they indicate that care must be taken in studies where more than one regulation-demanding task is being administered, due to depletion effects on later tasks as a function of earlier tasks.

A limitation of the present study is the failure to include a control task that was experienced as comparably difficult to the Color Stroop paradigm but that did not impinge on self-regulation resources (cf. Schmeichel, 2007). We cannot therefore rule out the possibility that the downstream effects on AMT specificity were a result of

Memory specificity and ego depletion

performing a difficult or challenging task, as opposed to one that targets self-regulation capacity.

In summary, the present study showed for the first time to our knowledge that reduced autobiographical memory specificity to cue words can be induced by self-regulation depletion on an unrelated, affectively neutral task. This extends work on self-regulation depletion to the abnormal psychology literature and has a number of implications for our understanding of cognitive-affective processing in the day-to-day.

Author note

Hamid Neshat-Doost, Department of Psychology, University of Isfahan, Islamic Republic of Iran. Hamid Neshat-Doost, Tim Dalgleish, Ann-Marie Golden, Emotion Research Group, Medical Research Council Cognition and Brain Sciences Unit, Cambridge, England.

This research was funded by the U.K. Medical Research Council and the government of the Islamic Republic of Iran. Correspondence concerning this article should be addressed to tim.dalgleish@mrc-cbu.cam.ac.uk

Memory specificity and ego depletion

Table 1 (continued on next page)

Participant characteristics across the 3 experimental conditions

	Color Stroop		Control Stroop		No Stroop		Test Statistic	<i>P</i> value
	<i>n</i> = 18		<i>n</i> = 14		<i>n</i> = 18			
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Age (years)	23.56	3.67	21.71	2.87	23.50	3.38	<i>F</i> = 1.47	0.24
Sex (M:F)	8:10		5:9		5:13		$\chi^2 = 1.09$	0.58
Education	6:2:4:5		5:2:7:0		2:5:9:2		Fisher's exact	0.10
NART Error	16.22	8.00	14.00	5.42	11.33	6.60	<i>F</i> = 2.30	0.11
BDI-II	8.94	8.32	4.50	5.16	4.28	3.85	<i>F</i> = 3.19	0.05
STAI-trait	38.06	11.01	34.79	8.16	33.06	4.02	<i>F</i> = 1.70	0.19
STAI- State	32.28	9.33	33.79	7.39	30.29	5.57	<i>F</i> < 1	0.45
IES-R Total	19.61	14.59	18.50	13.42	14.33	11.41	<i>F</i> < 1	0.46
MDD current	1:17		0:14		0:18		Fisher's Exact	n.s
MDD past	7:11		5:9		9:9		$\chi^2 = 0.77$	0.68

Memory specificity and ego depletion

Table 1 continued

	Color Stroop		Control Stroop		No Stroop		Test Statistic	<i>P</i> value
No. of Stroop trials	370.00	61.74	850.29	105.13	-	-	$t = 261.41$	< 0.01
Stroop errors	5.22	4.65	0.86	1.17	-	-	$t = 11.70$	< 0.01
Stroop difficulty	56.67	26.07	26.07	25.05	-	-	$t = 11.22$	< 0.01
Tired	44.33	22.53	44.29	28.34	41.25	18.08	$F < 1$	0.95
Thought- ful	37.17	23.87	36.07	20.49	49.38	18.01	$F = 1.10$	0.34
Worn out	51.50	23.87	38.57	25.90	48.13	22.02	$F = 1.15$	0.33
Excited	34.61	24.65	24.64	16.81	28.13	15.10	$F < 1$	0.39
Happy	56.83	17.00	58.92	10.22	55.62	10.50	$F < 1$	0.84
Sad	17.11	23.10	14.64	14.87	17.50	21.88	$F < 1$	0.92
Angry	7.11	15.06	4.642	10.82	8.75	17.27	$F < 1$	0.79
Calm	63.06	22.03	66.07	25.73	74.38	12.37	$F < 1$	0.49

PTO for note

Memory specificity and ego depletion

Table 1 note

M=Male; F=Female; Education - High School:Diploma:Graduate:Postgraduate;

NART = National Adult Reading Test; BDI = Beck Depression Inventory; STAI=

Spielberger State-Trait Anxiety Inventory; IES=Impact of Event Scale; MDD

current/past = whether questions a1 and a2 on the Structured Clinical Interview for

DSM indicated that current/past Major Depressive Disorder was likely:unlikely.

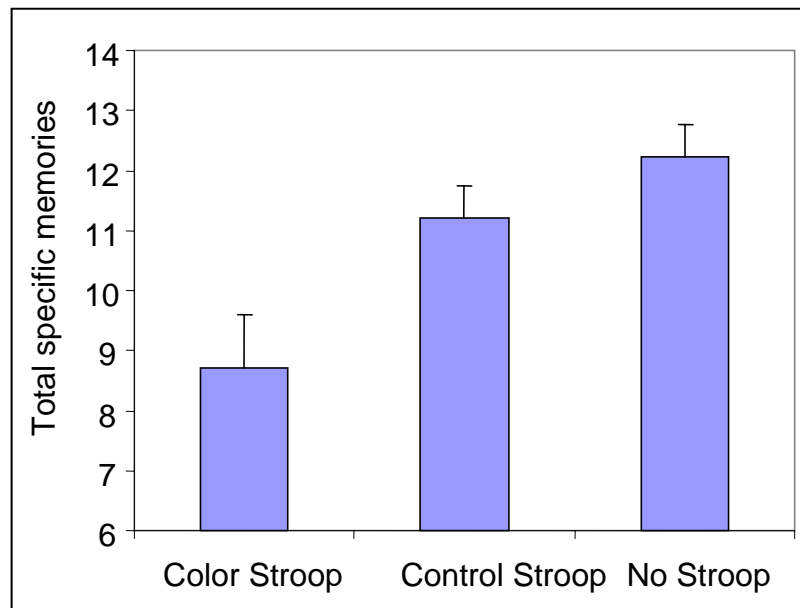
Memory specificity and ego depletion

Figure 1

Mean (+ 1 *SE*) total numbers of specific memories across the Color Stroop, Control Stroop and No Stroop conditions on the Autobiographical Memory Test.

Memory specificity and ego depletion

Figure 1



References

- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*(5), 1252-1265.
- Barrett, L. F., Tugade, M. M., & Engle, R. W. (2004). Individual differences in working memory capacity and dual- process theories of the mind. *Psychological Bulletin*, *130*, 553-573.
- Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory, 2nd ed.* San Antonio, TX: The Psychological Corporation.
- Brittlebank, A. D., Scott, J., Williams, J. M. G., & Ferrier, I. N. (1993). Autobiographical memory in depression: State or trait marker? *British Journal of Psychiatry*, *162*, 118-121.
- Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self- memory system. *Psychological Review*, *107*(2), 261-288.
- Dalgleish, T., Rolfe, J., Golden, A. J., Dunn, B. D., & Barnard, P. J. (2008). Reduced autobiographical memory specificity and posttraumatic stress: Exploring the contributions of impaired executive control and affect regulation. *Journal of Abnormal Psychology*, *117*, 236-241.
- Dalgleish, T., Tchanturia, K., Serpell, L., Hems, S., De Silva, P., & Treasure, J. (2003). Self-reported parental abuse relates to autobiographical memory style in patients with eating disorders. *Emotion*, *3*, 211-222.

Memory specificity and ego depletion

- Dalgleish, T., Williams, J. M. G., Golden, A. M. J., Perkins, N., Barrett, L. F., Barnard, P. J., et al. (2007). Reduced specificity of autobiographical memory and depression: The role of executive control. *Journal of Experimental Psychology-General*, *136*, 23-42.
- DeWall, C. N., Baumeister, R. F., Stillman, T. F., & Gailliot, M. T. (2007). Violence restrained: Effects of self-regulation and its depletion on aggression. *Journal of Experimental Social Psychology*, *43*, 62-76.
- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1997). *Structured Clinical Interview for DSM-IV*. Washington DC: American Psychiatric Press.
- Gailliot, M. T., Schmeichel, B. J., & Baumeister, R. F. (2006). Self-Regulatory Processes Defend Against the Threat of Death: Effects of Self-Control Depletion and Trait Self-Control on Thoughts and Fears of Dying. *Journal of Personality and Social Psychology*, *91*, 49-62.
- Golden, A. J., Dalgleish, T., & Mackintosh, B. (2007). Levels of specificity of autobiographical memories and of biographical memories of the deceased in bereaved individuals with and without complicated grief. *Journal of Abnormal Psychology*, *116*, 786-795.
- Kane, M. J., & Engle, R. W. (2003). Working memory capacity and the control of attention: the contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General*, *132*, 47-70.
- McNally, R. J., Lasko, N. B., Macklin, M. L., & Pitman, R. K. (1995). Autobiographical memory disturbance in combat-related posttraumatic stress disorder. *Behaviour Research and Therapy*, *33*, 619-630.

Memory specificity and ego depletion

- Muraven, M., & Baumeister, R. F. (2000). Self-Regulation and Depletion of Limited Resources: Does Self-Control Resemble a Muscle? *Psychological Bulletin*, *126*, 247-259.
- Muraven, M., Collins, R. L., & Nienhaus, K. (2002). Self-control and alcohol restraint: An initial application of the self-control strength model. *Psychology of Addictive Behaviors*, *16*, 113-120.
- Nelson, H. E. (1991). *National adult reading test (NART): test manual (revised)*. Windsor, U.K.: NFER-Nelson.
- Ramponi, C., Barnard, P., & Nimmo-Smith, I. (2004). Recollection deficits in dysphoric mood: An effect of schematic models and executive mode? *Memory*, *12*, 655-670.
- Schmeichel, B. J. (2007). Attention control, memory updating, and emotion regulation temporarily reduce the capacity for executive control. *Journal of Experimental Psychology-General*, *136*, 241-255.
- Schmeichel, B. J., Vohs, K. D., & Baumeister, R. F. (2003). Intellectual performance and ego depletion: Role of the self in logical reasoning and other information processing. *Journal of Personality and Social Psychology*, *85*, 33-46.
- Spielberger, C. D., Gorsuch, R. L., & Lushene, R. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*, 643-662.
- Vasey, M. W., Dalglish, T., & Silverman, W. (2003). Research on information processing factors in child and adolescent psychopathology: A critical commentary. *Journal of Clinical Child and Adolescent Psychology*, *32*, 81-93.

Memory specificity and ego depletion

- Vohs, K. D., & Heatherton, T. F. (2000). Self-regulatory failure: A resource-depletion approach. *Psychological Science, 11*, 249-254.
- Weiss, D. S., & Marmar, C. (1997). The Impact of Event Scale -Revised. In J. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD* (pp. 399-411). New York: Guilford.
- Whooley, M. A., Avins, A. L., Miranda, J., & Browner, W. S. (1997). Case-finding instruments for depression - Two questions are as good as many. *Journal of General Internal Medicine, 12*, 439-445.
- Williams, J. M. G., Barnhofer, T., Crane, C., Hermans, D., Raes, F., Watkins, E., et al. (2007). Autobiographical memory specificity and emotional disorder. *Psychological Bulletin, 133*, 122-148.
- Williams, J. M. G., & Broadbent, K. (1986). Autobiographical memory in suicide attempters. *Journal of Abnormal Psychology, 95*(2), 144-149.
- Yeung, C. A., Dalgleish, T., Golden, A. M., & Schartau, P. (2006). Reduced specificity of autobiographical memories following a negative mood induction. *Behaviour Research and Therapy, 44*, 1481-1490.

Footnotes

¹ We also sought to rule out any potential effects of depressed mood by trimming the Color Stroop group of the 4 participants with the highest BDI scores thus providing groups matched on the BDI, $F < 1$. We then repeated the key ANOVA for numbers of specific memories, using the trimmed Color Stroop sample. The results again revealed a significant effect of Condition, $F(2,43) = 9.27$, $P < .001$, $\eta_p^2 = .30$, and post Hoc LSD tests revealed that the trimmed Color Stroop group generated fewer specific memories ($M = 8.21$, $SD = 3.56$) than the Control Stroop group, $P = .005$, $d = 1.04$, and the No Stroop group, $P < .0001$, $d = 1.33$, again with enhanced effect sizes relative to the comparable analyses with the full Color Stroop group.

² The data distributions for numbers of categoric memories were marginal for parametric statistics. We therefore repeated these analyses using a non-parametric Kruskal Wallis test. Again, there was a significant effect of Condition, $\chi^2 (df = 2) = 6.33$, $P < .05$, with the Color Stroop generating more categoric memories than the Control Stroop group, $\chi^2 (df = 1) = 5.12$, $P < .05$, and showing a strong trend to be more categoric than the No Stroop group, $\chi^2 (df = 1) = 3.37$, $P < .066$.