

BRIEF COMMUNICATION

Directed forgetting in depression

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Abstract

Subjects with depression exhibit deficits in prefrontal function. We posited that as a result, in a supraspan memory test, they would be impaired in their ability to inhibit recall of irrelevant words, and because of consequent overload of working and episodic memory capacity, would be impaired in their ability to recall relevant words. We tested this hypothesis in 30 inpatients and outpatients with a diagnosis of major depressive disorder and 30 controls subjects using a form of the Directed Forgetting Paradigm using exclusively neutral words. The depressed subjects did exhibit deficits in prefrontal function. All subjects were given four lists of 24 items each, in which half the words were followed by the instruction “remember” and half by the instruction “forget.” Our hypothesis found support in a significant group by item type interaction effect exhibited when subjects were instructed to recall only those items followed by the “remember” instruction: depressed subjects recalled relatively more words to be forgotten and relatively fewer words to be remembered. A control experiment suggested that these results could not be accounted for by a differential effect of depression on memory encoding. (*JINS*, 2008, *14*, 895–899.)

Keywords: Depression, Inhibition, Memory, Retrieval, Working memory, Directed forgetting task

INTRODUCTION

Depression is associated with impairment on tests of memory encoding (Burt et al., 1995), and impairment in autobiographical memory (Lemogne et al., 2006a). Autobiographical memory includes autobiographical events (episodic memory) and autobiographical facts (semantic memory) (Lemogne et al., 2006b). Depressed patients often exhibit overgenerality of recall: an excessive tendency to recall repeated events or classes of events over single, specific events (Lemogne et al., 2006a; Williams et al., 2007). Recalled memories are less specific, irrespective of the emotional valence of the memory. This suggests a fundamental cognitive disorder rather than impairment linked specifically to the mood disturbance (Van Vreeswijk & De Wilde, 2004).

Memory retrieval may occur automatically or intentionally. Executive processes are hypothesized to play an important role in intentional retrieval of specific autobiographical memories: to remember new information, it is necessary to distinguish it from older information, but also to stop old information from interfering with new information (Conway & Pleydell-Pearce, 2000). Executive processes are also necessary to maintain a final search result in working memory (Williams et al., 2007). In a meta-analysis, Miyake et al. (2000) identified three core executive processes relevant to intentional retrieval: shifting between mental sets, updating and monitoring of working memory representations, and inhibition of dominant, automatic, or prepotent responses.

Because executive resources seem to play an important role in generative retrieval of specific autobiographical memories, and subjects with depression exhibit deficits in executive function (Uekermann et al., 2008), we hypothesized that the difficulties in retrieving specific memories exhibited by subjects with depression (the overgenerality phenomenon) may be related to a deficit in executive inhibitory

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mechanisms. Bjork (1989) studied these mechanisms in normal subjects using the Directed Forgetting Paradigm. In this test, a series of stimuli is presented, some of which are “to be remembered,” and others “to be forgotten.” Subjects are then asked to recall as many of the items “to be remembered” as possible, then to remember all the items, both those “to be remembered” and those “to be forgotten.” To the degree that one is successful at this task, there are few intrusions of to be forgotten items when participants are asked to report only to be remembered items and performance on to be forgotten items is relatively poor when, on a later retention test, participants are asked to report both to be remembered and to be forgotten items (Zacks et al., 1996). In this study, we used the Directed Forgetting Paradigm to test our hypothesis regarding the mechanism underlying the overgenerality of memory phenomenon in depression. Our hypothesis was that the difficulty in retrieval of specific episodic memories exhibited by subjects with major depressive disorder may be caused by difficulty in inhibiting irrelevant information, thereby overloading working memory. We posited that depressed subjects should recall more words to be forgotten than normal controls, because of defective executive inhibitory mechanisms, and depressed subjects should recall less words to be remembered because of the resultant overloading of working and episodic memory capacity. We also used a delayed test of recall of all items to rule out the possibility that the results of our experiment might reflect differential effects of depression on memory encoding.

MATERIALS AND METHODS

The study was performed on consecutive inpatients and outpatients examined at the Psychiatric department of the University Hospital of LILLE (France). It was approved by the Ethics Committee. All subjects gave their informed consent to participate in the study. To be included, patients had to have a diagnosis of major depressive episode, according to the DSM-IV criteria (American Psychiatric Association, 1994), that had been present for at least 2 weeks. They were screened for the study using a semi-structured interview, MINI DSM IV; Sheehan et al., 1998). We excluded patients with a score lower than 25 on the Montgomery and Asberg Depression Rating Scale (MADRS, Montgomery & Asberg, 1979). We also excluded patients with cerebral lesions, those with known memory disorders before the current episode of depression, those with other psychiatric or addictive disorders (assessed with MINI DSM IV; Sheehan et al., 1998), and those with paranoid, schizoid, schizotypal, antisocial, or borderline personality disorders (clinical assessment according to the DSM-IV Axis II criteria; American Psychiatric Association, 1994). The patients were allowed to continue the psychotropic treatment they were receiving at the beginning of the study but no psychotropic drug treatment changes were allowed during the study. We included 30 patients and compared them with 30 healthy controls.

Neuropsychological evaluation included the Verbal Fluency Test, the Stroop Task (Stroop, 1935), an abridged version of Wechsler’s Revised Intelligence Scale for Adults (Britton & Savage, 1966; Wechsler, 1989), including four subtests (Crawford et al., 1992), and the Wechsler Memory Scale (Wechsler, 1991).

We designed a Directed Forgetting Task that was an adaptation of the Directed Forgetting Paradigm of Zacks et al. (1996). Four lists of 24 words each were successively shown to the subjects. The 24 words in each list belonged to 6 different semantic categories. Each word was shown on a card for 5 seconds. On the next card, the instruction: “REMEMBER” or “FORGET,” was shown for 2 seconds. Each list included 12 words to be remembered and 12 words to be forgotten. The instruction was given after the word had been shown so that the subjects did not know in advance which words were to be remembered and which were to be forgotten. The instruction “REMEMBER” was randomly assigned to two of the four words in each semantic category. The words in each list were chosen from commonly-known French literature, controlling for frequency (between 100 and 10,000/million) using the BRULEX database (Content et al., 1990). Different semantic categories included words of comparable frequency. Only emotionally neutral categories and words were used. Homophonic words were excluded. There was no significant difference in the frequency of the words in the four lists ($p = .95$).

The order in which the lists were shown, the categories within the lists, and the words within categories were randomized. This order was used with all participants. After being shown each of the four lists, the subjects had to remember as many as possible of the words to be remembered, in a maximum time of 2 minutes (the immediate conditional recall phase). Over the next 10 minutes, the subjects were asked for biographical information [last name, first name, date of birth, address, phone number, medical situation, family situation, job situation, years of education, and treatment (psychotherapy, psychotropic drugs, and others)]. They were then asked to remember all of the words from the 4 lists, both those to be remembered and those to be forgotten, in a maximum time of 5 minutes (the final unconditional recall phase). Subject scores for each phase consisted of number of words to be remembered that were recalled, number of word to be forgotten that were recalled, and the number of repetitions and intrusions (words not in the lists, but recalled by the participants).

Neuropsychological testing was performed by the same two trained psychologists (G.deF., J.S.). All other tests were performed by the same two trained psychiatrists (O.C., G.G.).

Statistical Analysis

Analysis was performed using SAS (V8.0, SAS Institute) software. Comparison of the mean values for the Directed Forgetting Task was made using a two-way analysis of covariance controlling for age and verbal IQ. Comparison of neuropsychological test results (verbal fluency, Stroop

Table 1. Description of the population and results of the complementary tests

		Controls (n = 30)		Depression (n = 30)				
Description of the population	Sex	20 F	10 M	23 F	7 M			
		Inpatients					25	
	History of Prior Depressive Episode					18		
	Number taking benzodiazepines					15		
	Number taking nonbenziazepine anxiolytics					11		
	Number taking antidepressants					28		
	Number taking neuroleptics					1		
	Number receiving psychotherapy					24		
		m	(sd)	m	(sd)	t	ddl	p
	Age	37.37	12.29	42.97	8.37	-2.063	51.132	.044
	Years of Education	13.80	2.94	13.60	2.51	.283	56.626	.778
	Duration of Depressive Episode (days)			114.7	182.9			
	MADRS (global score)			33.07	6.63			
WAIS-R	Verbal IQ	118.17	(22.82)	108.6	(16.5)	1.854	52.839	.069
	Performance IQ	105.1	(18.84)	100.5	(17.0)	.992	57.413	.325
	Total IQ	114.63	(21.34)	108.9	(17.6)	1.143	55.932	.258
WMS	Verbal Memory	101.77	(23.25)	92.3	(15.2)	1.860	49.953	.069
	Visual Memory	117.6	(12.31)	101.3	(13.9)	4.814	57.156	<.0001
	General Memory	110.57	(13.94)	94.8	(14.7)	4.245	57.821	<.0001
	Attention Concentration	100.7	(17.19)	88.1	(13.2)	3.178	54.295	.002
	Differed recall	113.97	(14.84)	95.7	(14.9)	4.746	57.999	<.0001
Verbal Fluency	Words beginning by P, R and V (sum)	65.27	(12.77)	48.93	(14.58)	4.615	57.01	<.0001
	Animals, Fruits and Furniture (sum)	64.83	(8.75)	59.70	(16.59)	1.499	43.97	.141
Stroop Test	Color-congruent condition time (seconds)	62.13	(12.49)	76.3	(18.8)	-3.407	50.963	.001
	Word-reading condition time (seconds)	46.53	(7.42)	53.8	(12.8)	-2.546	48.086	.014
	Color-incongruent condition time (seconds)	111.97	(21.67)	147.0	(46.5)	-3.457	42.534	.001

task, WAIS-R, and WMS) for the depressed subjects and the controls was performed using *t* tests.

RESULTS

We examined 95 patients presenting with depression; 53 were not eligible for inclusion because of a history of alcohol abuse, cannabis abuse, personality disorder, bipolar disorder, posttraumatic stress disorder, or MADRS < 25. Of the 42 who were eligible for inclusion, 30 were included in the study, and 12 refused to participate. Demographic data are presented in Table 1. There was no difference between the depressed and control groups in gender distribution or education. The depressed subjects were significantly older ($t = 2.063$; $p = .044$).

Results of the Directed Forgetting Task

Immediate conditional recall (Figure 1)

Analysis of covariance controlling for the effects of age and verbal IQ revealed a group effect ($p = .0255$), meaning

that the depressed subjects recalled significantly fewer words overall than the controls [controls = 9.44 (SD 1.67); depressed subjects = 8.46 (SD 1.84)]; a directed forgetting effect ($p = .0001$), meaning that individually, the two groups recalled significantly more words “to be remembered” than words “to be forgotten”; and an interaction effect ($p = .0024$). Figure 1 reveals that this interaction reflects the combined effect of worse recall by depressed subjects of to be remembered items and greater intrusion in depressed subjects of words to be forgotten.

Final unconditional recall (Figure 2)

Analysis of covariance controlling for the effects of age and verbal IQ revealed a group effect ($p = .0290$), meaning that the depressed subjects recalled significantly fewer words overall than the controls [controls = 42.00 (SD 11.22); depression = 31.13 (SD 10.50)]; a directed forgetting effect ($p < .0001$), meaning that individually, the two groups recalled significantly more words “to be remembered,” than words “to be forgotten”; but no interaction effect ($p = .1455$). Figure 2 reveals that this absence of a significant inter-

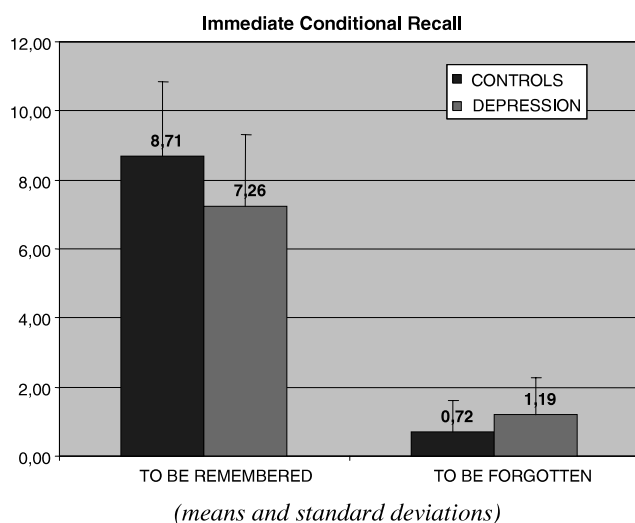


Fig. 1. Items recalled by depressed subjects and controls during the immediate conditional recall phase.

action reflects the finding that the likelihood of intrusion of words to be forgotten was not less for control subjects than for depressed subjects.

We did not find any list or verbal IQ effect, any significant effect from intrusions or word repetition, or any significant difference between patients taking or not taking benzodiazepines. However, we did find that age had an influence on immediate ($p = .01$) and delayed recall ($p = .002$) for both items to be remembered and items to be forgotten in depressed subjects.

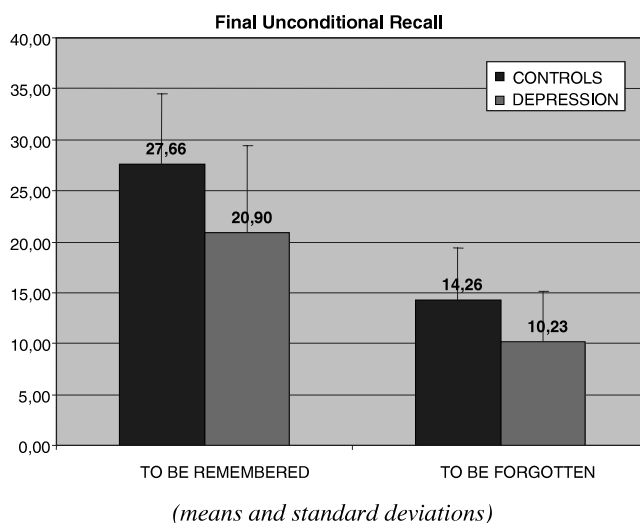


Fig. 2. Items recalled by depressed subjects and controls during the final unconditional recall phase.

Results of the complementary tests (Table 1)

The intelligence quotients of depressed subjects did not differ significantly from those of controls (Table 1). However, the depressed group did score significantly lower on the Wechsler Memory Scale, the Verbal Fluency Test, and the Stroop. These results are consistent with published data.

DISCUSSION

We posited that subjects with depression have deficits in prefrontal function and consequently, in the Directed Forgetting Paradigm, may not be able to inhibit words “to be forgotten,” may recall proportionally more words “to be forgotten” (the overgenerality phenomenon), and because of the resultant burden placed on working and episodic memory, may recall less words to be remembered. We found, as have others, that our depressed subjects did exhibit deficits in prefrontal function, and our results for the immediate conditional recall phase of our Directed Forgetting Test support our hypothesis that depressed subjects would recall proportionately less words to be remembered and more words to be forgotten (as reflected in the significant group by item type interaction effect). One could argue that the deficits exhibited by our depressed subjects reflected a problem with encoding. However, the equal effect on items to be remembered and items to be forgotten in depressed and control populations that was evident during the final unconditional recall phase suggests that the two classes of items were encoded similarly in the two groups. Therefore, it seems likely that the results during the immediate conditional recall phase did indeed reflect what happens at time of retrieval.

It is possible that the depressed subjects, rather than exhibiting impaired ability to inhibit recall of to be forgotten items, were unduly susceptible at time of retrieval to the salience in a memory task of the somewhat peculiar instruction to “FORGET” following certain words. The relative impact of deficits in inhibiting recall of irrelevant information/excessive susceptibility to salience of certain stimuli on early episodic memory and memory in various degrees of consolidation (e.g., after a night’s sleep) remains to be determined.

Although the depressed subjects were older than the controls, and age did negatively impact recall, our findings on the Directed Forgetting Test cannot be accounted for by age effects because they were significant when age was controlled.

The results from published studies of the Directed Forgetting Task (DFT) in depressed subjects have until now been contradictory. Dumont (2000) found a similar directed forgetting effect in depressed patients and in healthy controls, but Power et al. found that patients with more severe depression recalled more negative words “to be forgotten” (Power et al., 2000). Thus, the results of Power et al. were similar to ours, but the effect they observed could have been due to the emotional valence of the words. We have replicated their results using neutral words.

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