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BRIEF COMMUNICATION

Recurrent personal memories during intoxication reported by patients with alcoholism

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ABSTRACT

Background. Experimental studies have demonstrated that alcohol has state-dependent effects on learning and memory. We, therefore, sought to determine if alcohol intoxication triggers selective retrieval of memories which could alter patterns of alcohol use.

Methods. Eighteen alcoholic patients were studied as well as a comparison group of 12 patients who abused cocaine, a drug not associated with memory state-dependence. Patients underwent a semi-structured interview to elicit information about recurrent personal memories experienced when intoxicated. Recurrent memories experienced during craving were also studied as a comparison condition.

Results. The prevalence of recurrent personal memories during intoxication was reported to be much higher for alcoholic patients compared with the cocaine-abusing patients. These experiences occurred more frequently than during craving, generally reflected prior disturbing events and were often reported to promote continued drinking.

Conclusions. The association of recurrently experienced personal memories with intoxication in alcoholic patients suggests, but does not establish, pharmacological state-dependence. Further studies of this memory phenomenon are indicated.

INTRODUCTION

State-dependent memory refers to stored information that is preferentially accessed when the subject is in a particular neurobiological state. This phenomenon has been studied most often in relation to drug exposure. Information stored while the animal or human subject is under the influence of a drug is later accessed from memory preferentially when re-exposed to that same drug. State-dependent memory has been demonstrated in humans most consistently for alcohol (Goodwin *et al.* 1969; Weingartner & Faillace, 1971; Overton 1972; Kent *et al.* 1986).

A clinical observation prompted this study. A 31-year-old married man was assessed after a suicide attempt prompted by his dismay at having assaulted his wife while he was in an intoxicated state. He was diagnosed as having alcohol abuse, heroin abuse, and major depression. The patient revealed that he only beat his wife when he was intoxicated with alcohol. This information is not surprising insofar as alcohol is known to have disinhibiting effects (Earleywine & Finn, 1991; Varma *et al.* 1994). However, when asked about the timing of his violence, he reported that drinking caused him to re-live the memory of discovering his wife's infidelity. The patient reported that this memory was re-created with almost hallucinatory vividness while intoxicated but was barely recalled when he did not drink. The association of these memories with alcohol intoxication suggests a state-dependent effect.

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We sought to determine if a sample of alcoholic patients also reported experiencing personal memories recurrently during intoxication. A semi-structured interview was developed to elicit information about such experiences. Other information pertaining to recurrent personal memories (hereafter referred to as RPMs) was obtained, namely their frequency, their emotional valence, and whether they altered the patients' drinking patterns.

It is possible that factors not involving state-dependence may account for RPMs during alcohol intoxication. Some patients, for instance, may have ruminative tendencies and are more prone to report such memories regardless of state. RPMs may also simply be a conditioned response to substance abuse behaviours. The hypothesis that RPMs experienced during alcohol intoxication reflected pharmacological state-dependence was therefore assessed on the basis of the following two predictions.

1 There should be a higher estimated frequency of RPMs reported by alcoholic patients for intoxicated compared with craving states; the latter can be thought of as a comparison condition reflecting the overall proneness of subjects to report such experiences.

2 There should be a higher prevalence of RPMs in patients with alcoholism *versus* patients who abuse cocaine insofar as there are no experimental data indicating that the latter drug has state-dependent memory effects. Studies exploring state-dependent memory effects using amphetamine, a drug sharing many pharmacological properties of cocaine, have been equivocal (Banerjee, 1975; Weingartner *et al.* 1982).

METHOD

Eighteen patients who abused alcohol but not cocaine during the 18 months prior to assessment were studied. These patients were recruited from a dual diagnosis in-patient treatment unit. A comparison group of 12 patients were also studied who in the 18 months prior to assessment abused cocaine but not alcohol. Seven of these patients were recruited from the same dual diagnosis treatment unit while five such patients were recruited from a drug rehabilitation facility.

Patients were excluded from the study if they were actively psychotic, had a neurological condition, or had an estimated IQ of 80 or less. Diagnostic classifications utilized DSM-III-R criteria as determined by the treating psychiatrist and independent chart review of one of the investigators (R. E. H.) and were made without attempting to discern whether these syndromes were primary or secondary to substance abuse. Diagnoses of alcoholic patients included major depression (5); bipolar disorder, manic (1); bipolar disorder, mixed (3); dysthymia (2); borderline personality disorder (2); and eating disorder (1). Diagnoses of cocaine-abusing patients included major depression (2); depressive disorder NOS (1); bipolar disorder, mixed type (1); bipolar disorder, manic type (1); and dysthymia (1). Patients from the drug rehabilitation facility did not qualify for any for Axis I diagnoses other than substance abuse.

The two groups were well matched with respect to gender (M/F ratio for alcoholic group = 13/5; M/F ratio for cocaine-abusing group = 8/4) and education (grade mean $\pm$ S.D. for alcoholic group = 12·9 $\pm$ 2·5; grade mean $\pm$ S.D. for cocaine-abusing group 12·3 $\pm$ 2·3). The alcoholic group was, however, somewhat older (mean $\pm$ S.D. age for alcoholic group = 39·6 $\pm$ 10·3, mean $\pm$ S.D. age for cocaine-abusing group = 30·23 $\pm$ 6·6, $t = 2{\cdot}79$, df = 28, $P < 0{\cdot}009$).

Subjects were informed that we wished to obtain information about experiences when craving drugs or alcohol and when in an intoxicated state. A semi-structured interview was administered which identified memories experienced recurrently in either of these two states. Memories solely of prior drug/alcohol seeking or use could occur by conditioned learning alone and therefore were excluded from our analysis. If such a memory was identified, a summary of the content of the memory was obtained. The patient was also asked to estimate the frequency with which the memory was re-experienced during intoxicated or craving states. If no memory occurred, the frequency was scored as zero. Using Likert-type scales the patient was asked to rate the emotional valence of these memories (1 = very pleasurable, 5 = very unpleasant). Finally, the patient was asked if the memory influenced his decision to continue to use drink alcohol or use cocaine and, if so, to describe these effects.

RESULTS

Recurrent personal memories associated with intoxication

Fourteen of 18 (78%) alcoholic patients reported RPMs during intoxication which are summarized in Table 1.

Nine memories were rated as unpleasant (scored either as four or five), and four were rated as pleasant (scored as one), and one was described as being both pleasant and unpleasant. Nine of fourteen RPMs were judged to have contributed to further drinking. Patients reported that the emotional pain associated with these memories – which emerged with onset of drinking – caused them to drink further to reduce their distress. One patient reported that further drinking was facilitated by the memory because it made him angry and he then wanted to feel even more angry.

For the cocaine-abusing comparison group, 4/12 (33%) patients reported RPMs, which are summarized in Table 2.

Three of these memories were rated as either unpleasant or very unpleasant. Two of four of these memories were judged to prompt further cocaine use.

The prevalence of RPMs reported by the two patient groups was significantly greater among alcoholic patients *versus* cocaine-abusing patients ($\chi^2 = 5{\cdot}93$, df = 1, $P < 0{\cdot}015$). Re-analysing the prevalence of intoxication-associated state-dependent memories for patients with and without psychiatric disorder did not reveal statistically significant differences ($\chi^2 = 0{\cdot}45$, NS).

Recurrent personal memories associated with craving

Eight (44%) alcoholic patients also reported RPMs associated with the craving state, while three (23%) patients in the cocaine-abusing group reported RPMs associated with the craving state. The difference in prevalence of RPMs in the craving state for the alcoholic versus cocaine-abusing patients was not statistically significant ($\chi^2 = 2{\cdot}5$, NS).

For alcoholic subjects, mean $\pm$ S.D. frequency of RPMs in the craving state was $24{\cdot}8 \pm 30{\cdot}4$, while the mean $\pm$ S.D. frequency of RPMs in the intoxicated state was $53{\cdot}8 \pm 39{\cdot}4$, a difference that was statistically significant (paired t test = 2·77, df = 17, $P < 0{\cdot}013$). In comparison, the difference in frequency of RPMs in the craving

Table 1. *Recurrent personal memories (RPM): alcoholic patients*

Patient No.	RPM details
1	Details of automobile accident, which occurred when patient was driving while drunk
2	Hearing of the death of a good friend from his friend's wife
3	Memories of a greatly missed girlfriend from the distant past
4	Memories of enjoyable times had with a girlfriend before he became physically ill
5	Memories of living together with ex-roommate
6	Memory of a phone call from mother informing patient of accident which caused brother's handicap
7	Memories of how hard patient's mother worked raising her six children
9	Memories of falling in love with a young man
10	Memories of good times with wife and children
11	Memories of fights between patient and his mother
12	Hearing that brother had died in a plane crash
16	Memory of parents beating patient up when a child
17	Seeing the distressed emotions on her children's face during aggressive outbursts of spouse
18	Memory of mistreating his girlfriend

Table 2. *Recurrent personal memories (RPM): cocaine-abusing group*

Patient No.	RPM details
2	Memory of family being 'perfect'
5	Memories of stealing from mother
6	Violent memories such as father beating mother and children and getting into fights
8	Memories of girlfriend calling him on phone

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versus intoxicated state for cocaine-abusing patients was not statistically significant (mean ± S.D. frequency of RPMs in the craving state = 21·5 ± 41·0; mean ± S.D. frequency of RPMs in the intoxicated state = 26·9 ± 43·8; paired *t* test = 0·27, df = 11, NS).

DISCUSSION

On the whole, predictions that prompted the study were born out by our findings. Alcoholic patients reported a high prevalence of RPMs when intoxicated whereas cocaine-abusing patients did not. The high frequency of RPMs associated with alcohol intoxication seemed not to reflect a generalized proneness to report such experiences insofar as they were reported significantly less frequently in the craving state. Differences in prevalence of RPMs in the intoxicated *versus* the craving state were not reported by the cocaine-abusing patients. The high prevalence of intoxication-associated RPMs reported by alcoholic patients did not appear to be due to the fact this group had a higher rate of psychiatric diagnoses. These observations suggest that intoxication-associated RPMs reported by alcoholic patients reflect pharmacological state-dependence.

An important limitation of our study, however, is that it is based on retrospective self-report data. Such data are always subject to misreporting. Moreover, alcohol and cocaine abuse may have confounded these reports. Alcoholism can interfere with memory even when a frank Korsakoff's syndrome is absent (Weingartner & Faillace 1971; O'Mahony & Doherty 1996). Moreover, chronic cocaine use also can disrupt memory capacity (O'Malley *et al*. 1992; Berry *et al*. 1993; Strickland *et al*. 1993; Beatty *et al*. 1995).

In addition, acute alcohol intoxication itself can induce a decrement in registering events that occur during the intoxicated state (Wickelgren, 1975). In contrast, cocaine intoxication may actually enhance learning new information in some contexts (Rodriguez *et al*. 1993). Therefore, a direct comparison of retrospective memory reports for the two drug conditions has limitations. Other drugs of abuse that interfere with memory during intoxication, such as benzodiazepines, have also been reported to have state-dependent effects on learning (Jackson, 1995) and, therefore, could not be used to create a contrasting comparison condition.

On the other hand, it is not clear how decreased accuracy of recall could produce the high prevalence of RPMs specifically associated with alcohol intoxication. Memory interference is more likely to cause an under-estimation of RPMs rather than an excess. One possibility is that alcoholic patients could have confabulated responses to our questions. Alcoholic patients are prone to confabulatory syndromes when suffering from an amnestic disorder. We cannot absolutely rule out this possibility. However, none of patients in the study had a frank amnestic disorder on the basis of standard clinical assessment. Moreover, their memory reports did not consist of haphazard assemblages of elements characteristic of confabulation. Their responses were generally focused, detailed descriptions of memories of specific events or persons. Therefore, attributing high frequency of RPMs to memory impairment secondary to alcoholism seems unlikely. Finally, if RPMs were generated primarily by alcohol-induced confabulation, it is unclear why the prevalence of these reports were not greater than those of cocaine-abusing patients in the craving state.

Another limitation of this study is that we did not determine the degree to which RPMs reported by alcoholic patients were also accessed during non-intoxicated states overall. There did seem to be some specificity associated with our findings since these memories generally were reported to occur less frequently during the craving state. An objection to using the craving state as a comparison condition, however, is that patients may have been more preoccupied with seeking alcohol, and therefore would tend to report fewer RPMs. Therefore, further information regarding the overall level of 'penetrance' of these memories needs to be gathered.

Along these lines, the contribution of depressive symptoms to the experience of recurrent memories is also somewhat uncertain. Most of the psychiatric diagnoses of patients in the study were in the affective disorder spectrum. One might expect, for instance, that ruminations associated with depressive-spectrum disorders could contribute to a high 'penetrance' of specific negative memories. A high rate of depressive symptomatology co-occurs with alcoholism (Schuckit *et al*. 1994; Brown *et al*.

1995). However, a re-analysis of our data did not reveal any differences in the prevalence of RPMs among patients who suffered from affective disorder *versus* those who did not. Nonetheless, covert depressive symptoms that did not qualify for a full affective disorder diagnoses could have been present in some patients. Therefore, the relationship between RPMs associated with intoxication and level of depressive symptomatology requires additional study.

Another question regarding these findings pertains to the fact that not all of the original events leading to RPMs for alcoholic patients occurred when they were intoxicated. This seems to clash with a traditional drug-induced state-dependent memory model where storage of the original memory occurs during that state. We, unfortunately, did not collect systematic data to address this issue. Some memories referred to events in childhood, for instance, and were unlikely to occur when the subject was in an intoxicated state. This observation is not absolutely inconsistent with our state-dependent memory model, however. It is possible that our brains store a memory trace not only of the original event but also subsequent re-experiences of this event as a memory (Minsky, 1986). If so, it is possible that a memory originally acquired in a non-intoxicated state could be later 'primed' in a state-dependent fashion if re-experienced while intoxicated and then 're-learned'. If so, human memory storage is not a one time affair but rather a dynamic process where the memory trace is periodically 'reshaped' by its subsequent re-experience. Altered memory accessibility associated with drugs of abuse may provide informative 'natural experiments' which shed light on this important issue.

Given the many limitations of this study it is premature to attribute alcohol-associated RPMs to pharmacological state-dependence. To assess this hypothesis more fully, additional studies are needed which examine: (*i*) non-retrospective data; (*ii*) the effects of depressive symptoms; (*iii*) prevalence of RPMs in different non-intoxicated states; and (*iv*) neuropsychological effects of alcohol intoxication and alcoholism itself.

Our findings may have potential clinical importance regardless of their psychophysiological nature. Alcoholic patients often reported that emergence of these painful memories soon after initiation of drinking prompted further drinking in order to reduce emotional pain associated with these memories. Perhaps alcohol use allowed patients to access unpleasant memories that were too painful when sober. A therapeutic approach is suggested where these memories are 'detoxified' using psychotherapeutic strategies analogous to these used to treat post-traumatic stress disorder memories (Foa *et al*. 1995). If patients learn better tolerance of these memories, their vulnerability to excessive drinking may be reduced.

In summary, although our findings are preliminary, they reflect potentially fruitful areas for future studies linking human memory processes and alcohol abuse.

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