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Compromises of integration, specificity and emotional content of self-defining memories in patients with opioid-use disorder

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ABSTRACT

Autobiographical memory plays a major role in the construction of identity. A particular type of memory has been described as more relevant in pursuit of personal goals: self-defining memory (SDM). In patients with opioid-use disorder (OUD), SDM recall has not yet been investigated despite deficits in the retrieval of autobiographical memories. This study aims to characterise SDM recall in OUD patients. Patients ($N = 25$) and non-dependent individuals ($N = 25$) were told to recall five SDM and to rate the emotion (valence and arousal) triggered during the retrieval. Specificity, valence, theme, integration and distance in time of the SDM were analysed while controlling for anxiety and depression levels. The SDM construction of the OUD patients was characterised by a lower specificity, more neutral memories and a lower integration, while emotions triggered during retrieval did not differ between the two groups. This may reflect an unsuccessful attempt to disconnect from one's own emotions in the OUD patients. This emotional disconnection and the difficulty of addressing meaning of past events may be due to substance use history coupled with the use of emotional strategies of avoidance. The implications for substance abuse relapse are discussed.

1. Introduction

Among the cognitive impairments that characterise individuals with opioid-use disorders (OUD), such as episodic and working memory deficits (Ersche & Sahakian, 2007; Gruber, Silveri, & Yurgelun-Todd, 2007; Li, Hao, & Hu, 2007), autobiographical memory (AM), which forms the memory of one's personal history, has received little attention in the literature. AM is important for the individual's identity construction and contributes to the individual's sense of self and goal pursuit in the context of everyday life (Conway & Pleydell-Pearce, 2000; Nelson & Fivush, 2004; Williams et al., 2007; Williams, Conway, & Cohen, 2008).

Among the different types of personal memories, self-defining memories (SDM) have been described as specifically involved in the development of personal identity because of their relevance to personal goals (Singer & Salovey, 1993). These memories help us define and explain who we are as individuals and play a key role in the meaning-making of past events and in their integration into our life stories (Blagov & Singer, 2004). Consequently, they contribute to maintaining a coherent and consistent sense of self. These memories refer to salient concerns or unresolved conflicts and are particularly activated when

personal goals are redefined (Singer, 1990), reflecting transition periods in the individual's life. Consequently, SDM often refer to past events that occurred in early adulthood (between the ages of 18 and 30), a key period for important life choices and crucial events, although these memories are distributed across all stages of life. This increased recollection of events from this period of life reflects "the reminiscence bump" (Dickson, Pillemer, & Bruehl, 2011). SDM are also characterised by a high emotional charge and vividness. As they are related to recurrent goals, they are often repetitively recalled by individuals. They are also linked to other similar memories in terms of the type of events, emotions, protagonists, goals or outcomes (Singer & Salovey, 1993; Blagov & Singer, 2004).

The close links between SDM and identity have been described in the integrated model of narrative identity developed by Singer, Blagov, Berry, and Oost (2013). These authors have suggested that memory specificity and the ability to attribute adaptive meaning to memories despite their potentially painful nature contribute to well-being and greater adjustment (Blagov & Singer, 2004). In contrast, deficits in the recall of SDM have been associated with a disrupted sense of self in psychological disorders such as schizophrenia (Berna et al., 2011), posttraumatic

stress disorder (Sutherland & Bryant, 2005) or bipolar disorder (Inder et al., 2008). In alcohol-dependent patients, SDM were studied in both recently abstinent and mid-term abstinent individuals. For both, a lack of specificity and a prevalence of negative memories were observed (Cuervo-Lombard, Raucher-Chéné, Barrière, Van der Linden, & Kaladjian, 2016; Nandrino & Gandolphe, 2017). Recently detoxified patients tended to recall more memories associated with drinking problems than do individuals in the general population (Cuervo-Lombard et al., 2016), but this is less observable in patients with a longer period of abstinence, who retrieved fewer memories related to success compared to individuals in the general population. These latter patients also displayed lower integration, reflecting difficulties in meaning-making (Nandrino & Gandolphe, 2017) and, consequently, a sense of self and a capacity for adaptation that may be weakened. Only the distribution of SDM over time seemed to be preserved. Previous observations have confirmed that AM retrieval, particularly SDM recall, was impaired in alcohol-dependent patients, demonstrating that AM deficits were associated with increased emotional distress with which patients may try to cope through substance abuse (Nandrino, Gandolphe, & El Haj, 2017).

Given the high level of emotional distress observed in substance abusers, the effects of mood disorders in AM impairments have been raised. Indeed, many studies have shown a deficit in AM recall in patients with major depressive disorder or with anxiety disorders, mainly characterised by difficulty in accessing specific memories (Sumner, 2012; Ono, Devilly, & Shum, 2015). However, the lack of specificity was still observable after controlling for depression in OUD patients (Gandolphe, Nandrino, Hancart, & Vosgien, 2013a) and for anxiety in alcohol-dependent patients (Cuervo-Lombard et al., 2016). In contrast, the role of mood disorders in the emotional valence of SDM remains uncertain. In alcohol-dependent patients, high levels of anxiety and depression have been linked to more negative and less positive SDM only in mid-term abstinent (Nandrino & Gandolphe, 2017) and not in recently detoxified patients (Cuervo-Lombard et al., 2016). This lack of consensus underlines the importance of taking into consideration the possible effect of anxiety and depression in SDM characteristics of dependent patients.

Considering the impact of SDM retrieval impairment on identity construction and its potential role in the adoption of risky behaviours, this impairment has been suggested as a major risk for substance abuse relapse. Knowing that OUD patients display a deficit in the recall of specific autobiographical memories, the study of SDM recall would allow investigation of complementary aspects of autobiographical recall in this population. The aim of the present study was to examine the characteristics of SDM in OUD patients in comparison to SDM recalled by a non-clinical population, while controlling for anxiety and depression levels. First, we hypothesised that the overgenerality phenomenon previously observed in OUD patients (Gandolphe et al., 2013a, 2013b) would also be confirmed in a situation of SDM retrieval. Based on previous studies conducted with patients with alcohol use disorders (Cuervo-Lombard et al., 2016; Nandrino & Gandolphe, 2017), we expected that the SDM of OUD patients would be less positive and more negative. As found in many clinical populations (Singer et al., 2013), particularly in patients with alcohol use disorders (Cuervo-Lombard et al., 2016; Nandrino & Gandolphe, 2017), we hypothesised that difficulty in learning lessons from the past and ascribing meaning to past experience would be reflected by a low integration. A higher prevalence of SDM related to substance abuse was also likely to be found, as the illness was frequently mentioned in SDM of other clinical populations, including alcohol users (Berna et al., 2011; Berntsen & Rubin, 2008; Cuervo-Lombard et al., 2016).

Finally, we explored the emotions triggered during SDM retrieval in terms of valence and arousal.

2. Method

2.1. Participants

Twenty-five detoxified patients with OUD (18 men and 7 women; *M* age = 36.32 years, *SD* = 7.11) and 25 non-dependent (ND) individuals (17 men and 8 women; *M* age = 36.76 years, *SD* = 9.95) took part in the study on a voluntary basis. They were included in the sample after providing their informed consent in accordance with the principles of the Declaration of Helsinki.

All participants were native French speakers. The exclusion criteria included a history of psychotic disorder, bipolar disorder, neurological disorder, head injury or intellectual deficiency. To assess their general cognitive functioning, the Montreal Cognitive Assessment scale (MoCA) (Nasreddine et al., 2005) was administered to each participant. The MoCA scores and demographic data are presented in Table 1.

Patients with OUD were recruited from the addiction departments of the Hénin–Beaumont hospital centre in the North of France. The diagnosis of OUD was made by a physician specialising in addictology according to the DSM-5 criteria. The patients did not have recent antecedents of addictive behaviours other *Snijders* than substance dependence. Patients who had been abstinent for less than 48 hours or for more than 1 year were excluded.

The ND participants were recruited among employees of the hospital centre. They did not have a history of any form of addictive behaviour (except nicotine use).

2.2. Procedure

In the OUD participants, the data concerning substance use history were obtained from the patients' medical records, whereas actual substance use was controlled by urine analysis. Concerning the clinical assessments and the

Table 1. Demographic characteristics of the participants (means and standard deviations).

	OUD group (n = 25)	ND group (n = 25)	Value	p	Cohen's d
Gender					
Male	72% (n = 18)	68% (n = 17)	χ2(1) = 0.09	p = 0.76	
Female	28% (n = 7)	32% (n = 8)			
Age	36.32 (7.11)	36.76 (9.95)	t(48) = 0.18	p=0.86	
Years of education			χ2(1) = 1.39	p = 0.50	
< baccalaureate	52% (n = 13)	40% (n = 10)			
= baccalaureate	36% (n = 9)	36% (n = 9)			
> baccalaureate	12% (n = 3)	24% (n = 6)			
Length of opioid abuse (years)	10.4 (6.88)	-			
	Range 1– 25				
Age at onset of opioid abuse	26.92 (8.16)	-			
	Range 13– 40				
Length of abstinence (days)	55.3 (93.13)	-			
	Range 1– 365				
Opioid maintenance treatment		–			
Methadone	76% (n = 19)	–			
Subutex®	12% (n = 3)	–			
Suboxone®	4% (n = 1)	–			
None	8% (n = 2)				
Other substance use					
Cannabis	60% (n = 15)	–			
Cocaine	32% (n = 8)	–			
Alcohol	28% (n = 7)	–			
Benzodiazepines	12% (n = 3)	–			
MoCA score	25.32 (2.91)	26.68 (2.03)	t(48) = 1.91	p = 0.06	
	Range 18–30	Range 21–29			
BDI score	13.56 (8.75)	3.52 (3.20)	t(48) = 5.39	p < 0.001*	1.52
STAI Y B scores	52.36 (10.25)	39.44 (6.36)	t(48) = 5.35	p <0.001*	1.51

SDM evaluation, both groups of participants were tested individually by psychologists specifically trained for this study. The total duration of the testing session was between 30 minutes and 1 hour.

Self-administered questionnaires were used to assess depression and anxiety levels. The level of anxiety was evaluated with the trait subscale of the state-trait anxiety inventory (STAI-Y B) (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), which contains 20 items on 4-point scales (from 1 to 4). Higher scores depict higher levels of anxiety. The level of depression was assessed with the shortened Beck Depression Inventory (BDI-13) (Beck, Steer, & Brown, 1996), comprising 13 items evaluating the presence of depressive symptoms. Higher scores indicated higher depression levels.

An adaptation of the procedure designed by Singer and Moffitt (1991) was used to assess SDM. Participants were told to recall five SDMs, which were described following the original instructions of Singer and Blagov (2002a): "An SDM is a personal memory with the following properties: (1) it is at least 1 year old, (2) it is a memory of an event that you remember very clearly and that is still important for you today, (3) it is a memory that helps you to understand who you are and that you would tell another person to help this person know you better as individual, (4) it is a memory of an important or enduring concern in your life and is related to similar memories sharing the same theme or referring to the same salient concern or unresolved conflict in your life, (5) it can be a positive or/and negative memory as long as it leads to strong emotions, (6) it is a memory which you often think about

and that has become familiar to you as a picture or a song that you have learned by heart".

The narratives of the five SDM of each participant were recorded and then transcribed after the testing session to facilitate their subsequent evaluation. Following each memory retrieval, participants were asked to date the memory as precisely as possible to determine the distance of the memory in time (months elapsed since the past event has occurred). Then, they rated the emotion triggered during the SDM retrieval (not the emotion they felt when they experienced the event in the past) in terms of valence and arousal on the Self-Assessment Manikin (SAM) scale, a nine-point pictorial scale that provides a valid assessment of subjective emotional experiences (Bradley & Lang, 1994). With regard to emotional valence, the SAM ranges from a happy figure (very positive) to a frowning figure (very negative). With regard to emotional arousal, the SAM ranges from an excited figure (high arousal) to a relaxed figure (no arousal).

All transcriptions of the SDM were blindly rated by independent judges according to different dimensions: the level of specificity (specific versus general), the integration of meaning (integrative versus non-integrative), the emotional valence of the narrative (positive, negative, neutral or mixed) and the main theme. The theme of each memory was determined using the seven categories described by Thorne and McLean (2001): (1) life-threatening events, including deaths, accidents, severe assaults or illness episodes; (2) recreation/exploration, including hobbies and pleasant activities; (3) relationship, including events referring to a particular interpersonal relationship

or emotional investment in someone else; (4) achievement, including events referring to effortful attempts at mastery or accomplishment regardless of their outcome (failure or success); (5) guilt/shame, including events that raised a kind of moral choice in terms of doing right or wrong; (6) substance use, including events referring to drug, alcohol or tobacco use; and (7) other or event not classifiable. To rate the level of specificity and the integration, the judges referred to the instructions described by Singer and Blagov (2002b).

Cohen's kappas were calculated to evaluate the interrater agreement for the level of specificity, the integration, the emotional valence and the themes. We reached a substantial agreement score for the different SDM dimensions evaluated: $0.60 < \kappa < 0.80$ (level of specificity, $\kappa = 0.76$; Emotional valence, $\kappa = 0.78$; Integration, $\kappa = 0.64$; theme, $\kappa = 0.71$) (Landis & Koch, 1977).

2.3. Statistical analysis

Clinical characteristics of the OUD patients and the ND participants were compared using chi-square tests for sex and education level, whereas t-tests for independent samples were conducted for age, depression (BDI-13 scores), anxiety (STAI-Y B scores) and global cognitive functioning (MoCA scores).

To examine the differences in the SDM characteristics between the OUD patients and the ND participants, we considered that the data set had a two-level hierarchical structure because each participant was asked to recall several SDM. Level 1 was the several SDM of each participant and Level 2 was the participants themselves. The SDM were thus "nested" within subjects, and as a consequence, we conducted a multilevel analysis by random intercept models with fixed effects (see, for example, Snijders & Bosker, 2012). This kind of analysis is recommended in study designs where collecting several data points per subject may challenge the statistical assumptions concerning the independence of the errors in conducting comparison inferences (Field, 2013; Snijders & Bosker, 2012). Here, to consider the intercept as random rather than fixed was a way to take into account the fact that the five SDM of a person might be more similar to each other than to an SDM of another person.

To better distinguish the effect of the groups (OUD patients versus ND participants comparison) on the characteristics of the SDM and the possible effects of the anxiety (STAI Y B score) and depression (BDI 13 score) levels, we first present the results of a model comparing the groups without controlling for anxiety and depression, and then the results of the model testing the effect of the group with anxiety and depression scores entered as covariates. In addition, to eliminate possible multicollinearity between the predictors, STAI Y B and BDI 13 scores were grand mean centred in the analyses. Group, anxiety and depression were entered in the analyses as fixed effects.

We also examined the respective fits of these two random intercepts with fixed effects models by examining their deviance (indicated by the log-likelihood of the model or "-2LL"). Smaller -2LL values of the model indicated a better fit of the model. If the model containing anxiety and depression as covariates (the "new model" that had additional parameters) was better when adjusted by those data, its -2LL value would be smaller than the -2LL value of the model containing only the group effect (the "old model"); it was considered a significant improvement in the model fit if the difference was greater than 5.991 (chi square value at $p = 0.05$ for 2 degrees of freedom, i.e., the number of parameters added in the "new model" in comparison with the "old model": STAI Y B and BDI 13 scores).

All analyses were conducted using SPSS software version 24 for Windows. Continuous outcomes (emotion valence and emotional arousal during the SDM retrieval) were treated using the "mixed" syntax. We used the maximum likelihood (ML) method to estimate the parameters and to compare the fits of the models, and the default variance components for the structure of the variance covariance matrix, because sufficient in random intercept models and applicable here because it does not require a large data set (see in example Field, 2013, for arguments in favour of the ML method, and variance component structure for random intercept models).

Analysis of the categorical outcomes (level of specificity, integration of meaning, emotional valence and theme) was conducted with the "Genlinmixed" syntax (see, for example Sommet & Morselli, 2017). For this purpose, we recoded data in a binary way (example of dummy codes: positive valence of the narrative = 1 for yes and 0 for no; with the OUD group = 1 and the ND group = 0). An odds ratio value greater than 1 indicated that for the OUD group compared to the ND group, the odds of the outcome occurring increased. In contrast, an odds ratio value less than 1 indicated a lower probability of the event of interest in the OUD group compared to the ND group. Because of the response repartition with $n < 5$ in some cases, analyses on the *Guilt/shame* and *Substance use* themes of memory could not be conducted.

For each variable, we report the F- and p-values of the model evaluating the effect of the group, and the B coefficient estimate with its confidence interval (CI 95%) and odds ratio (OR) when significant and depending on the type of the variable. The same indicators were reported for the effect of the group with anxiety and depression scores entered as covariates.

Pearson's correlation tests were performed to examine the relationships between opioid abuse characteristics (length of abstinence, length of opioid abuse and age at onset of opioid abuse) and SDM characteristics: specificity (number of specific SDM), emotional valence (number of positive, negative, neutral or mixed SDMs) and integration (number of integrated SDM) in the OUD patients. Given the numbers of themes and the size of the sample, we do not present the correlations between the themes and the clinical variables.

For all tests, the level of significance was set at $p \leq .05$.

3. Results

3.1. Group comparison of clinical characteristics

There were no differences between patients with OUD and the ND individuals with regard to sex ($\chi^2(1) = 0.09$, $p > .10$), education level ($\chi^2(2) = 0.67$, $p > .10$) and age ($t (48) = 0.18$, $p > .10$). Global cognitive functioning was similar in the two groups, with MoCA scores of the OUD patients ($M_{MOCA} = 25.32$, SD = 2.91) that did not differ significantly from the MOCA scores of the ND participants ($M_{MOCA} = 26. 68$, SD = 2.04) ($t (48) = 1.91$, $p > .05$).

Concerning anxiety and depression, patients with OUD had more depressive ($M_{BDI-13} = 3.56$, SD = 8.75) and anxious symptoms ($M_{STAI-Y B} = 52.36$, SD = 10.25) than the ND individuals ($M_{BDI-13} = 3.52$, SD = 3.20; $M_{STAI-YB} = 39.44$, SD = 6.36). These differences were significant, with a large effect size for the depression (BDI-13) score, $t (48) = 5.39$, $p < 0.001$, $d = 1.52$, and the anxiety (STAI-Y B) score, $t (48) = 5.35$, $p < 0.001$, $d = 1.51$. These results, concordant with previous studies, confirmed the need to control for the confounding effect of anxiety and depression in subsequent analyses.

3.2. Group comparison of SDM characteristics

The frequency distribution and frequencies of SDM according to the level of specificity, emotional valence and integration of meaning and theme in the OUD and ND groups are presented in Table 2.

Concerning specificity, comparison of the OUD group versus the ND group showed that the OUD patients had a lower probability of reporting a specific (versus non-specific) memory ($F_{1,48} = 12.754$, $p < 0.001$, $B = $ -1.295, CI_{95} [0.134; 0.559], OR = exp (−1.295) = 0.274, Model -2LL = 1081.479). The probability of recalling integrated SDM (versus nonintegrated) was also decreased in the OUD group compared to the ND group ($F_{1,48} = 4.523$, $p < 0.05$,

$B = −0.833$, CI_{95} [0.201; 0.940], OR = exp (−0.833) = 0.435, Model -2LL = 1104.992).

The valence of the SDM was also impacted by the group: being in the OUD group more than tripled the probability of recalling a neutral memory compared to being in the ND group ($F_{1,48} = 6.885$, $p < 0.01$, $B = 1.284$, CI_{95} [0.318; 2.250], OR = exp (1.284) = 3.611, Model -2LL = 1208.894). There was a decrease in the odds ratio for the OUD group to recall a positive memory compared with the ND group ($F_{1,48} = 5.830$, $p < 0.05$, $B = −0.691$, CI_{95} [0.285, 0.881], OR = exp (−0.691) = 0.501, Model -2LL = 1058.569). There was no significant group effect for mixed valence ($F_{1,48} = 0.499$, $p = 0.481$, Model -2LL = 1169.52) and negative valence ($F_{1,48} = 1.336$, $p = 0.249$, Model -2LL = 1126.168).

Concerning the themes of the recalled SDM, we found a significant group effect for the probability to recall events related to relationships. The OUD patients, compared to the ND participants, reported more of these types of events ($F_{1,48} = 5.937$, $p < 0.01$, $B = 0.722$, CI_{95} [1.148; 3.691], OR = 2.059, Model -2LL = 1088.505). In contrast, events recalled by the OUD patients had a significantly lower probability of being related to the "achievement" theme ($F_{1,46} = 4.699$, $p < 0.05$, $B = −0.766$, CI_{95} [0.232; 0.932], OR = 0.465, Model -2LL = 1119.53) compared to those recalled by the ND participants. The themes "life threatening event" ($F_{1,48} = 0.564$, $p = 0.453$, Model -2LL = 1178.420), "recreation/exploration" ($F_{1,48} = 0.981$, $p = 0.323$, Model -2LL = 1220.894) and "others" ($F_{1,48} = 0.505$, $p = 0.478$, Model -2LL = 1293.303) occurred at the same frequency in the two groups. As previously mentioned, an analysis could not be conducted for the "guilt" and "substance use" themes (see Table 2).

3.3. Group comparison of SDM characteristics with anxiety and depression as covariates

The comparison of the groups after adjusting for depression and anxiety scores showed that being in the

Table 2. Characteristics of SDM in OUD and ND groups.

		OUD group		ND group	
		N (or mean)	% (or SD)	N (or mean)	% (or SD)
Level of specificity	Specific	43	35	81	65
	General	79	65	44	35
Emotional valence	Positive	43	35	65	52
	Negative	33	27	26	21
	Neutral	28	23	10	8
	Mixed	18	15	24	19
Integration of meaning	Integrated	27	22	48	38
	Non integrated	95	73	77	62
Theme	Life-threaten. event	24	20	20	16
	Recreation	13	11	19	15
	Relationship	48	39	30	24
	Achievement	22	18	40	32
	Guilt/shame	0	0	2	2
	Substance use	5	4	0	0
	Other	10	8	14	11
SDM total		122	100	125	100
Mean distance in months (SD)		172.74	134.99	157.15	122.47
Retrieval induced	Mean valence (SD)	4.03	3.05	3.91	3.04
emotions	Mean arousal (SD)	4.91	2.93	3.98	2.71

Level of specifity
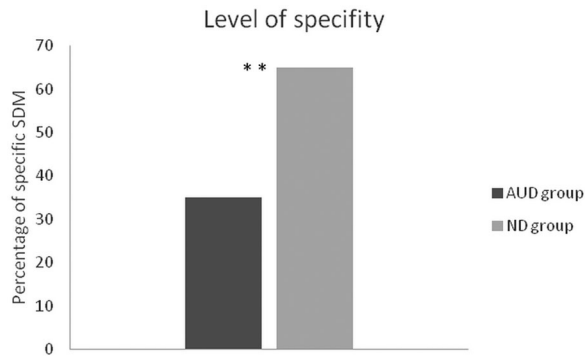
Figure 1. Percentage of specific memories in AUD group versus OD group. Significant effects of the group adjusted on anxiety and depression were indicated with *$p < 0.05$ or **$p < 0.01$.

Integration of meaning
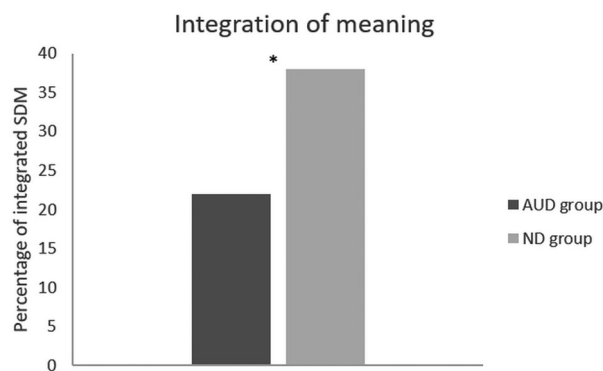
Figure 2. Percentage of integrated memories in AUD group versus OD group. Significant effects of the group adjusted on anxiety and depression were indicated with *$p < 0.05$ or **$p < 0.01$.

OUD group (versus the ND group) decreased the probability of reporting a specific (versus nonspecific) memory ($F_{1,46} = 6.903$, $B = -1.275$, CI_{95} [−2.23; −0.319], $p < 0.01$; OR = exp (−1.275) = 0.279; Model -2LL = 1095.198). Concerning integration of the SDM, the probability of recalling integrated SDM (versus non-integrated) also decreased in the OUD group compared with the ND group ($F_{1,46} = 5.211$, $p < 0.05$, $B = -1.219$, CI_{95} [−2.271; −0.167], OR = exp (−1.219) = 0.295; Model -2LL = 1120.215) (Figures 1 and 2).

There was a significant group effect on the probability of reporting neutral SDM ($F_{1,46} = 5.991$, $p < 0.05$, $B = 1.493$, CI_{95} [0.291, 2.694], OR = exp (1.493) = 4.45). The odds ratio indicated that being in the OUD group, compared to the ND group, more than quadrupled the probability of recalling a neutral memory (Model -2LL = 1226.880). No difference was found for the positive valence ($F_{1,46} = 0.328$, $p = 0.568$; Model -2LL = 1074.579), the negative valence ($F_{1,46} = 0.742$, $p = 0.390$; Model -2LL = 1150.078) and the mixed valence ($F_{1,46} = 0.625$, $p = 0.430$; Model -2LL = 1182.257) (Figure 3).

Concerning themes, the results showed no significant group effect on the theme recalled when adjusted for anxiety and depression: "life threatening event" theme ($F_{1,46} = 0.183$, $p = 0.669$; Model -2LL = 1184.564), "recreation/exploration" theme ($F_{1,46} = 0.017$, $p = 0.897$; Model -2LL = 1233.572), "relationship" theme ($F_{1,46} = 0.534$, $p = 0.466$; Model -2LL = 1105.327), "achievement" theme ($F_{1,46} = 1.265$, $p = 0.262$; Model -2LL = 1134.233), and "others" theme ($F_{1,46} = 0.011$, $p = 0.915$; Model -2LL = 1301.350) occurred at the same level in the two groups.

Concerning the distance in time of the SDM recalled, patients with OUD recalled memories as distant ($M = 174.526$, $SE = 19.742$) as ND participants did ($M = 155.54$, $SE = 19.537$) ($F_{1,46} = 0.372$, $p = 0.545$).

3.4. Group comparison of SDM retrieval-induced emotion

There were no significant differences in the SDM emotional valence rated by the OUD patients ($M = 3.787$, SE = 0.328) compared to that by the ND participants ($M = 4.150$, SE = 0.323) ($F_{1,48} = 2.106$, $p = 0.153$; Model -2LL = 1249.146) or in the emotional arousal triggered by SDM retrieval ($F_{1,48} = 0.088$, $p = 0.768$; Model -2LL = 1108.242).
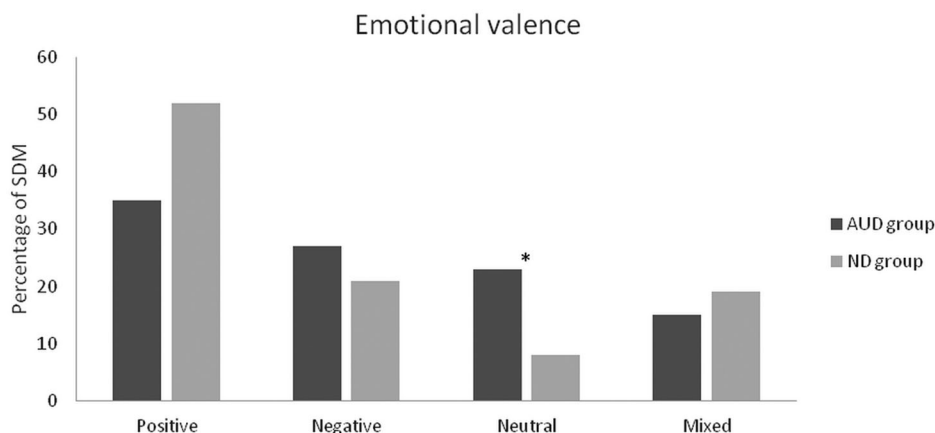
Emotional valence

Figure 3. Percentage of memories according to the emotional valence in AUD group versus OD group. Significant effects of the group adjusted on anxiety and depression were indicated with *$p < 0.05$ or **$p < 0.01$.

Table 3. Correlations between anxiety and depression levels, opioid abuse characteristics and SDM characteristics.

| | | Emotional valence | | | | |
	Level of specificity	Positive	Negative	Neutral	Mixed	Integration
Length of abstinence	0.23	−0.12	−0.00	−0.05	0.29	0.34
Length of abuse	−0.21	0.05	−0.10	0.21	−0.09	−0.01
Age at onset of abuse	0.03	0.10	0.20	−0.48**	0.21	0.13

*$p < 0.05$; **$p < 0.01$.

3.5. Group comparison of SDM retrieval-induced emotion with anxiety and depression as covariates

When controlling for anxiety and depression, neither SDM emotional valence, $F_{1,46} = 0.498$, $p = 0.484$; Model -2LL = 1247.206, nor emotional arousal, $F_{1,46} = 0.048$, $p = 0.828$; Model -2LL = 1104.109, triggered by SDM retrieval showed differences between the OUD patients and ND participants.

The comparison of the model fits showed that adding anxiety and depression into the analyses did not significantly improve the quality of the models.

3.6. Relationships between opioid abuse characteristics and SDM characteristics

Pearson's correlation coefficients, conducted to explore possible relationships between opioid abuse characteristics and SDM characteristics in patients with OUD, are presented in Table 3.

The age at onset of use was negatively correlated with the number of neutral memories, meaning that an earlier age of initial consumption was linked to more neutral SDM recalled. There were no other significant correlations between substance abuse characteristics (length of abstinence, length of use and age at onset of use) and SDM characteristics (level of specificity, emotional valence and integration).

4. Discussion

This study aimed to characterise SDM in patients with OUD and the emotion triggered during the recall of these SDM. The comparison of SDM in OUD patients with those of ND individuals showed that the SDM in the clinical population were less specific, had more neutral content and were less integrated. However, the themes mentioned by the OUD patients in their SDM, as well as the emotions triggered during the SDM retrieval in terms of valence and arousal, were not different from those of the ND individuals.

The reduced specificity observed for SDM is in accordance with previous studies showing the overgenerality phenomenon in patients with substance use disorder, including OUD patients (Gandolphe & Nandrino, 2011; Gandolphe et al., 2013a, 2013b). This result was found after controlling for depression and anxiety, suggesting that the presence of mood disorders cannot solely account for this bias, as has already been observed in this population of patients (Gandolphe et al., 2013a,

2013b). As some authors have previously suggested, common mechanisms such as a particular emotional functioning or a modification of executive abilities may play a role in the lack of specificity, rather than the diagnosis of mood disorders (Sumner, 2012).

In the OUD patients, a lack of emotional differentiation may compromise the reach of specific memories in the autobiographical database, resulting in a retrieval process truncated at a general level (Gandolphe et al., 2013a). Furthermore, as formulated by the functional avoidance hypothesis of over general memory by Williams et al. (2007), retrieving memories at a general level may protect individuals from the resurgence of painful emotional details. Emotional difficulties, both in terms of emotional information processing and emotion regulation skills, are potential candidates for impeding autobiographical retrieval in patients with OUD. Poor emotion regulation skills may lead individuals to elicit maladaptive emotional regulation strategies, such as avoidance strategies to set aside emotional material. Retrieving memories at a general rather than a specific level may be considered one of these strategies used by OUD individuals (Gandolphe, Nandrino, Hancart, & Vosgien, 2013b).

Concerning the emotional valence of the SDM recalled, the prevalence of neutral SDM differs between the OUD patients and the ND individuals. A lower prevalence of positive SDM was also found in the OUD patients, but this difference was no longer observable when anxiety and depression were controlled for. Previous studies in alcohol-dependent patients also showed differences in the recall of negative and positive SDMs, when both anxiety and depression were not controlled for (Nandrino & Gandolphe, 2017; Cuervo-Lombard et al., 2016). Consequently, the absence of a difference in the prevalence of positive and negative SDM, after taking into account anxiety and depression in our results, supports the assumption of Nandrino and Gandolphe (2017) that the presence of mood disorders may impact the emotional valence of SDM in patients with substance use disorders. In addition, the higher prevalence of neutral memories in the OUD patients in comparison to the ND individuals provided further evidence to support the functional avoidance hypothesis in OUD patients. Indeed, these results indicated that the presence of impoverished emotional content in OUD patients' SDM may result from painful emotion distancing or disconnection.

However, the subjective evaluation of emotions triggered during the SDM retrieval in terms of valence and arousal on the SAM scale was not significantly different

for the OUD and ND participants. The similar evaluations of emotions may have indicated that this attempt to keep emotions away was not sufficient and that despite a more neutral narrative content, the OUD patients still felt the emotion associated with past events. This absence of difference in the evaluation of emotion triggered during the recall may have also been due to the difficulty of substance-dependent patients to accurately rate their own emotions. Indeed, impaired emotional recognition in OUD patients has been widely described in the literature (Carton et al., 2010; Gandolphe et al., 2013a) with a lack of awareness of their emotional difficulties (Aguilar de Arcos, Verdejo-Garcia, Peralta-Ramirez, Sanchez-Barrera, & Perez-Garcia, 2005). Consequently, OUD patients may also be unaware of this attempt at emotional disconnection during their narrative discourse.

Nevertheless, if the diminished emotional content of the SDM supported the hypothesis of emotional avoidance during autobiographical retrieval in OUD patients, it may have also been the result of impoverished emotional information at the encoding stage. Indeed, substance consumption itself may be considered an emotion regulation strategy, especially as it can be used to avoid painful emotional responses (Cheetham, Allen, Yücel, & Lubman, 2010; Kober, 2014). Consequently, individuals who used psychoactive substances at an early age would have been less likely to have encoded the emotional information, as emotional content may have been set aside during a crucial period for the construction of self-identity, such as during the period of the reminiscence bump. This would explain why the more OUD individuals recall neutral memories, the earlier is their age at onset of abuse. Furthermore, despite the fact that the emotional quality of core memories was impacted in OUD patients, there are no differences in the temporal distance of the SDM recalled between the OUD and ND groups. Based on these considerations, it would be an interesting perspective for future research to examine the characteristics of SDM for events encoded before the onset of substance use and during the period of opioid use.

In addition to this emotional content of the SDM, the ability to attribute meaning to their past experiences was impacted in OUD patients as they recalled fewer integrated memories. This result was in line with previous studies of alcohol-dependent patients who demonstrated difficulty in stepping back from their experience to derive a particular lesson or understanding about life or themselves (Nandrino & Gandolphe, 2017). Nevertheless, this ability to ascribe meaning to memories is particularly important for daily life adaptation as integration constitutes a marker of socio-emotional maturity and overall personal adjustment (Blagov & Singer, 2004). Consequently, the lack of integration observed in several populations of patients with substance use disorders may indicate the role of integration in the adoption of risky behaviours such as substance use.

Another result of this study was the absence of a difference between the OUD patients and the ND individuals in

the recalled topics when anxiety and depression were controlled for. However, the OUD patients described fewer SDMs associated with an achievement theme and more SDMs associated with a relationship theme when anxiety and depression were not considered in the model. A previous study in alcohol-dependent patients showed some differences for specific themes. A lower frequency of SDM with achievement themes was previously found in people with alcohol use disorder and has been argued to be a consequence of low self-esteem, which may create a negative bias in the selection of recalled information (Nandrino & Gandolphe, 2017). This perspective is consistent with our previous suggestion that mood states in the OUD patients may have influenced recall content. Concerning the relationship theme, it would be interesting to consider whether those memories in the OUD patients referred more to aversive content (such as divorce, conflict, loneliness) that was potentially associated with anxious or depressive symptoms, which may explain why this effect disappeared when those variables were adjusted for.

Indeed, even if it cannot be completely confirmed with the actual analyses, the influence of mood disorders may be considered with regard to both emotional and event contents, as these two dimensions have been shown to be related (Blagov & Singer, 2004). Our results with anxiety and depression as covariates must be considered with prudence because while controlling for such variables is often done in psychopathology studies, this method can be arguable when comparing naturally occurring groups (Miller & Chapman, 2001).

Furthermore, it has been observed that with abstinence durations of greater than 6 months, alcohol abusers seem to no longer define themselves by their drinking experiences (Nandrino & Gandolphe, 2017), unlike recently abstinent patients (Cuervo-Lombard et al., 2016). As our group was composed of patients with recent to mid-term abstinence, the effect of abstinence duration on the recall of substance abuse-related SDM should be further investigated in OUD patients with longer periods of abstinence.

To summarise the main results of this study, SDM in OUD patients, compared with ND individuals, were characterised by a lower specificity, more neutral content and a lower integration of meaning, whereas there were no differences in the subjective evaluation of emotion triggered during the recall both in terms of arousal and valence between OUD patients and ND individuals. These results seem to reflect a global impoverishment of past experiences in both the emotional and cognitive aspects that patients may be unaware of and may constitute a major risk for relapse as it impedes personal adjustment. The emotional disconnection may be due to emotional avoidance strategies used during the retrieval process (such as overgenerality), but it may also be the result of an emotional avoidance functioning (as attested for substance abuse) that may have impeded the nature of the autobiographical content itself, with a disruption of SDM consistency. Substance abuse coupled with the use of

emotional regulation strategies such as avoidance reinforces this lack of coherence and the loss of connection between the different memories. The access to emotional memories and their inner connections has become a promising therapeutic target, as it may help patients to maintain a richer sense of identity and to develop an ability to project themselves into the future.

Even if our results deserve further investigation to evaluate some other variables that may impact the narrative content of participants (such as alcohol use or other indicators of socioeconomic status, in particular education level), these initial observations support the need to integrate emotional aspects into the therapy of individuals suffering from substance abuse. This therapeutic axis may include a rehabilitation of emotional competencies, especially to enhance emotion regulation, but the goal may also be to foster better access to emotional content. In this way, some therapeutic approaches, such as training in emotion regulation (e.g ART; Berking, 2014) or Emotion-Focused Therapy, integrate the importance of working with experiential, narrative and emotional processes. It has been suggested that fully experiencing emotion by expressing core specific autobiographical events is fundamental both for self-construction and to induce a transformation of emotions by providing new meaning to the old story (Angus & Greenberg, 2011).

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