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**Autobiographical memories of delusion-like experiences
and their relation to the self in the psychosis continuum**

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1. Introduction

Delusional beliefs are frequent clinical manifestations of psychosis. They are one of the key symptoms for the diagnosis of schizophrenia, but are also found at various levels of intensity within the psychosis continuum ranging from nonclinical subjects to people diagnosed with a mental illness (Freeman, 2007; Van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009). According to cognitive models of delusions, delusions are considered as a breakdown of normal belief formation (Bell, Halligan, & Ellis, 2006; McKay, Langdon, & Coltheart, 2007; see also; Connors & Halligan, 2014) and their formation and persistence derive from cognitive, emotional, and perceptual abnormalities (Blackwood, Howard, Bentall, & Murray, 2001; Freeman, 2007; Garety & Freeman, 1999; Moritz et al., 2010).

1.1. Delusions, autobiographical memory and the self

In his review about memory and delusions, Kopelman underscored that “although delusions are not themselves a memory phenomenon, they become integrated into memory” (Kopelman, 2010 p.27). In fact, delusional beliefs of patients with schizophrenia are typically anchored in daily life situations (for instance, believing that the hospital food was poisoned after an indigestion). The memories of such situations may thus provide confirmatory evidence contributing to the maintenance of delusional beliefs (Freeman, 2007 p.449). Nonetheless, studies that examined memory bias in relation to delusions used episodic, non-ecological material (Kaney, Wolfenden, Dewey, & Bentall, 1992; Larøi, D’Argembeau, & Van der Linden, 2006; Taylor & John, 2004; for review; Lepage, Sergerie, Pelletier, & Harvey, 2007). In contrast very few studies examined memories of past personal events (also called autobiographical memories) (e.g., Baddeley, Thornton, Chua, & McKenna, 1995; Berna et al. 2014; David & Howard, 1994; Vorontsova, Garety, & Freeman, 2013). However, Connors and Halligan (2014, p.10) suggested in their review paper of cognitive models of belief that memory bias affecting particular categories of memories of past events may contribute to the construction and/or maintenance of beliefs.

In addition, we think that assessing autobiographical memory is relevant for a better understanding of delusions. Firstly, according to the model of the Self-Memory System put forward by Conway (2005), autobiographical memory is intimately connected with the self so that the self “grounds” on the memories of past events. Memories of particularly important events such as self-defining memories (Moffitt & Singer, 1994) or turning points (McAdams, 2001) exert stronger impact on the self than trivial personal events. In some case, psychotic experiences can be experienced by patients as “self-defining” leading them to reconsider themselves and their beliefs about other persons and the world in a completely

different way (Berna et al., 2011; Chadwick, 2007; Lysaker, Tsai, Maulucci, & Stanghellini, 2008). Memories of psychotic episodes can thus provide material supporting a representation of self as “someone with mental illness” but also the view of self “someone very important” in the case of delusions of grandiosity.

1.2. Experimental studies investigating autobiographical memory in relation to delusions

A recent experimental study (Vorontsova et al., 2013) examining different factors involved in the maintenance of delusions in patients with schizophrenia included a measure of autobiographical memory specificity, which corresponds to the capacity to recall memories of unique past events. The authors found no significant contribution of autobiographical memory impairment to delusions’ maintenance, but the memories investigated in this study were cued by means of positive and negative cue words that did not trigger specifically memories relating to delusions. Another study (David & Howard, 1994) examined the characteristics of delusional memories in a small sample of four patients diagnosed with schizophrenia, who presented with this relatively rare symptom linked to persistent delusions. They showed that delusional memories had higher clarity and were more emotionally intense than both memories of real and imagined events used as comparative memories. It is worth mentioning that delusional memories correspond to the retrieval of improbable personal events in the form of memories. These memories have lost any contact with true events but are highly consonant with the current delusional theme of the patients.

In a recent paper, we have proposed a cognitive model of persecutory delusions (Berna et al., 2014) based on Conway’s model of autobiographical memory (Conway, 2005). We suggest that persecutory delusions involve a biased memory of events associated with persecutory content and could be conceived as a particular form of abstract knowledge deriving from abstraction and semantization processes affecting memories of past events. More precisely, the repeated recording of memories associated with a feeling of persecutory would make them less and less distinctive with time and lead to the semantization of the delusional belief that is common to these experiences. The semantization process in memory may then lead memories to lose their uniqueness and to become summarized in the form of an abstract and conceptual representation. This representation evolves then gradually to a persistent delusional belief. At this stage, we hypothesize that patients may access vivid and emotional memories of delusional experiences, as they are consonant with their delusional beliefs (and contain confirmatory knowledge to these beliefs). In contrast, experiences with a content dissonant with the delusional self may be less easily retrieved (bias against non congruent knowledge). We experimentally tested aspects of this model using a diary method (Berna et al., 2014). Basically, participants with schizophrenia and control participants were asked to record daily events

associated or not with persecutory content in their diary during a period of two months. Our results showed that memories of daily life experiences associated with persecutory content were less distinctive and more schematized than other daily life experiences without persecutory content, providing some support to our hypothesis. Moreover, persecutory events that were altered on one element of their content and presented to the participants during a recognition test were more often falsely recognized as true events in comparison to non-persecutory events. This means participants had more difficulty accessing details stored in their autobiographical memory to disconfirm altered presentations of persecutory events. In contrast, the intensity of emotions associated with memory retrieval of persecutory events and the consonance between their persecutory content and the belief of the participants were pointed as two factors providing “confirmatory evidence” for the veracity of the altered description of the persecutory events. Altogether, these studies have paved the way for further investigations of the role of autobiographical memories for a better understanding of delusions. They also revealed contradictory results by showing that memory of events with persecutory experience are less detailed and more schematized than other memories (Berna et al., 2014) and that delusional memories are more clear and vivid than other memories (David & Howard, 1994). The fact that patients included in the latter study had more severe delusions than those included in the former raises here the issue of the role of delusions severity in the characteristics of the memories of delusional experiences. Moreover, as both studies investigated limited aspects of the memories of delusional experiences, the exploration of a larger set of delusional or abnormal beliefs is needed to examine further the relationship between autobiographical memories and delusions.

1.3. Aim and prediction

The aim of the present study was to investigate autobiographical memories of delusion-like experiences (for instance the feeling to be a very special or unusual person, or that electronic devices can influence the way we think) that stand out from the usual experiences of daily life and that can be encountered with various frequency and intensity both by people with and without of psychotic disorder (Fach, Atmanspacher, Landolt, Wyss, & Rössler, 2013; Van Os et al., 2009; Verdoux & van Os, 2002). More specifically, we were interested in examining the phenomenological characteristics of these memories (namely the vividness and emotional experience associated with their retrieval) and how these experiences are considered central to the self (namely, how these experiences are considered self-defining or as having a critical impact on the self). We decided to address this issue in a sample of patients diagnosed with schizophrenia. We then decided to examine whether similar patterns of results may be observed in another sample of non-clinical participants, this in order to find out

processes that may be shared within the psychosis continuum. In line with previous results mentioned above, we hypothesized that memories of delusion-like experiences would be more vivid, emotionally intense and central to the self in individuals in people with high delusion-proneness or high delusions severity

2. Study 1

2.1. Material and method

2.1.1. Participants

Seventeen outpatients (14 men) were recruited at the Psychiatry Department of the University Hospital of Strasbourg and took part in the study. They all met the DSM-5 criteria for schizophrenia or schizo-affective disorder. They were all clinically stabilized, but some of them presented with residual delusional ideas despite receiving appropriate antipsychotic treatment. All of the patients were being treated with second generation antipsychotics. This study was approved by the Ethic Committee of Lille III.

Table 1: Socio-demographic characteristics of the participants in Study 1 ($N = 17$)

	<i>M</i>	<i>SD</i>
Age (years)	33.12	(7.89)
Gender	14/3	82%
Level of schooling (years)	12.12	(2.29)
f-NART	105.28	(8.23)
Age at illness onset (years)	21.15	(5.77)
Duration of illness (years)	11.97	(7.32)
PDI total score	12.12	(4.64)
PDI preoccupation	29.12	(16.37)
PDI distress	28.59	(16.69)
PDI conviction	28.29	(15.46)
PANSS total	64.94	(18.10)
PANSS positive	17.00	(6.54)
PANSS negative	18.59	(7.34)
PANSS general	29.35	(8.34)
PSYRATS-D	6.59	(5.76)
PSYRATS-HA	1.59	(6.55)
SUMD	4.06	(1.89)
CDSS	1.18	(1.29)

Note: f-NART = French version of the National Adult Reading Test;

PDI = Peter's et al Delusion Inventory;

PANSS = Positive And Negative Syndrome Scale

PSYRATS = Psychotic Symptoms RATING Scale

D for delusion subscale, HA for hallucination subscale

SUMD = Scale of Unawareness of Mental Disease

CDSS = Calgary Depression Scale for Schizophrenia

2.1.2. Procedure

After giving their informed consent, patients were subjected to a clinical examination followed by psychometric evaluations. Patients

were then asked to complete the Peters et al. Delusion Inventory (PDI; Peters et al., 2004). Each rated PDI-item was later used as a cue to retrieve one memory of a past event related to this experience. Patients were also asked to retrieve 5 positive and 5 negative memories without delusion-like content. Finally, the characteristics of the memories were rated by the participants.

2.1.2.1. Clinical examination

Each patient was examined by a senior psychiatrist (FB) in order to assess clinical symptoms using the Positive And Negative Syndrome Scale (PANSS; Kay, Fiszbein, & Opler, 1987) and the Psychotic Symptom Rating Scales (PSYRATS; Haddock, McCarron, Tarrier, & Faragher, 1999). The PANSS comprises three subscales for positive, negative, and general symptoms of schizophrenia and the PSYRATS comprises two subscales for hallucinations (PSYRATS-H) and delusions (PSYRATS-D). As the PSYRATS-D provides a more precise and detailed evaluation of delusions than the positive subscale of the PANSS, the PSYRATS-D was used for correlation analyses to reflect severity of delusions. The French validated version of the National Adult Reading Test (f-NART; Mackinnon & Mulligan, 2005) was used in order to assess premorbid IQ. Demographic and clinical characteristics of patients are presented in Table 1.

2.1.2.2. Peters et al. Delusion Inventory (PDI)

Patients were then invited to complete the PDI (Peters et al., 2004). This questionnaire comprises 21 items that assesses delusion-like experiences (for instance item 5: “Do you ever feel as if there is a conspiracy against you?”). Participants are asked first to answer whether or not they have ever experienced each item and if yes, to assess on 3 different 5-point Likert scales the level of distress, preoccupation, and conviction associated to each experience. A cut-off score of 8/21 has been determined in Preti et al. (2007) with a sensitivity of 74% and a specificity of 79% for psychotic disorders.

2.1.2.3. Cueing of memories and rating of memory characteristics

Patients were then asked to retrieve one memory of a particular delusion-like experience related to each PDI items rated with the following instruction: “Please try to remember a past situation in which you had the feeling there was a conspiracy against you” (item 5). They also had to indicate their age at the time of the event. A short title was given for each memory, but the patients were not asked to relate the memory at this moment. Patients were then asked to retrieve 5 positive and 5 negative memories. The total number of memories retrieved varied between individuals depending on the number of PDI items they had previously rated. Similarly to David and Howard (1994), in order to avoid that the remoteness of positive and negative memories differ from memories relating to PDI, patients were instructed to retrieve memories

dating from the most remote to the most recent delusion-like experience previously retrieved. Again, the title of each memory was collected first. When all memory titles were obtained, patients were invited to narrate their memories following a random order.

2.1.2.4. Phenomenological characteristics of memories

After each memory, patients were asked to rate its vividness, emotional valence and intensity associated with remembering, and the frequency of occurrence of similar events using 7-point scales (Johnson et al., 1988).

2.1.2.5. Centrality of Events Scale (CES)

Then for each event, patients were invited to complete the short version (7 items on 5-point Likert-type scale with 1 = totally disagree and 5 = totally agree) of the Centrality of Events Scale (Berntsen and Rubin, 2006), that assessed the extent to which the events had become a reference point for personal identity (e.g., “I feel that this event has become a central part of my life story”; “This event has become a reference point for the way I understand myself and the world”).

2.1.3. Statistical analysis

Separate analyses of variance (ANOVA) were performed in order to compare the phenomenological characteristics and centrality scores of the memories using the type of memories (positive vs. negative vs. delusion-like) as within-subjects factors.

Then the Pearson’s correlation coefficients were calculated in order to examine the relationship between severity of delusion (PSYRATS-D) and memory vividness, emotional intensity, emotional valence and centrality of memories in all categories of events. As vividness, emotional intensity and centrality of memories were expected to correlate with each other, coefficient correlations between these variables were also calculated.

2.2. Results

2.2.1. Phenomenological characteristics and centrality of memories

Significant effects of type of memories were found for memory vividness, emotional valence and for centrality of events (all $ps < .03$) but not for emotional intensity, frequency and age at time of events (all $ps > .078$) (see Table 2).

Post-hoc analyses revealed that delusion-like memories were less detailed than positive and negative memories but differences were significant only with positive ($p = .035$) and not with negative memories ($p = .078$). The emotional valence of delusion-like memories was also rather neutral ($M = 3.93/7$, $SE = .30$), that is significantly less positive than positive memories ($p < .001$) and significantly less negative than negative memories ($p = .028$). Finally, positive memories were considered more central than negative and delusion-like memories but the differences between categories did not reach significance (all $ps > .052$).

2.2.2. Correlation analyses

The centrality of memories was significantly correlated with emotional intensity and vividness in both delusion-like and negative memories (but not in positive memories).

Significant positive correlations were observed between PSYRATS-D and centrality of delusion-like and negative memories, and between PSYRATS-D and emotional intensity of negative but (not delusion-like) memories. Finally, the correlation between PSYRATS-D and memory vividness memories was not significant (see Table 3)

Partial correlations entering vividness and emotional intensity as covariate revealed that the correlation between PSYRATS-D and centrality of events remained significant for delusion-like memories ($r = 0.72, p = .004$) but not for negative memories ($r = 0.27, p = .35$).

2.3. Discussion

Study 1 showed that autobiographical memories of delusion-like experiences in patients with schizophrenia are rather emotionally neutral. They are significantly less emotionally intense and less vivid than positive memories but do not differ significantly from negative memories in terms of emotional intensity and vividness. Similarly, the centrality of delusion-like memories was lower than that of positive memories but did not significantly differ from that of negative memories. According to our predictions, the severity of delusion was significantly and positively correlated with centrality of delusion-like, but contrary to our predictions, vividness and emotional intensity of delusion-like memories were not significantly correlated with PSYRATS-D ($r_s < 0.44, p_s > .08$). Finally, PSYRATS-D was significantly correlated with both emotional intensity and centrality of negative memories, this showing that the severity of delusion may not impact specifically on the characteristics of delusion-like memories but also or more generally on memories with negative tone.

However, our results were obtained in a rather small sample of patients. This may have affected the statistical power of our analyses and limits the generalization of our results to both schizophrenia and to the psychosis continuum. Taken these limitations into account, we conducted a second web-based study with similar design. We added a measure of clarity of self-concept and of self-esteem in order to examine the impact on psychosis proneness on those variables as well as the relationship between those new variables and the centrality of delusion-like memories.

Table 2: Phenomenological characteristics and centrality of positive, negative and delusion-like memories of participants in Study 1

	Positive (P)		Negative (N)		Delusion-like (DL)		<i>F</i>		Statistics	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			η_p^2	
Age at time of events	20.91	(6.07)	21.26	(5.48)	22.39	(5.52)	2.04	ns	0.11	P = N = DL
Vividness (1-7)	5.16	(1.29)	4.78	(1.54)	4.26	(1.32)	5.57	**	0.26	P > DL
Emotional valence (1-7)	6.18	(0.48)	2.35	(0.74)	3.67	(1.10)	110.6	***	0.87	P > DL > N
Emotional intensity (1-7)	4.65	(1.33)	4.14	(1.49)	3.90	(1.18)	5.51	**	0.26	P > DL
Frequency (1-7)	2.61	(0.88)	2.39	(0.85)	3.15	(1.01)	2.94	ns	0.25	P = N = DL
Centrality (CES) (1-5)	3.18	(0.78)	2.80	(0.92)	2.72	(0.82)	4.92	*	0.25	P = N = DL

Note: CES = Centrality of Event Scale

Table 3: Correlation coefficients between memory characteristics and severity of delusion symptoms in participants in Study 1

	Positive				<i>V</i>	Negative				<i>V</i>	Delusion-like		
	<i>V</i>	<i>EV</i>	<i>EI</i>	<i>CES</i>		<i>EV</i>	<i>EI</i>	<i>CES</i>	<i>V</i>		<i>EV</i>	<i>EI</i>	<i>CES</i>
PSYRATS-D	0.01	-0.14	0.33	0.35	0.24	0.23	0.63 **	0.57 *	0.34	0.05	0.44	0.79 ***	
Vividness (<i>V</i>)		0.58 *	0.55 *	0.39		0.20	0.56 *	0.66 **		0.47	0.46	0.57 *	
Emotional valence (<i>EV</i>)			0.17	0.33			0.36	0.07			0.09	0.08	
Emotional intensity (<i>EI</i>)				0.49				0.73 ***				0.55 *	

Note: PDI = Peter's et al Delusion Inventory; CES = Centrality of Event Scale

3. Study 2

3.1. Material and Method

This study was performed online and the participants were recruited via internet platforms of undergraduate psychology students in Strasbourg and Nancy (France). A link to the study was also posted to the website of a French center for clinical and scientific research on parapsychology (CIRCEE, www.circee.org). The message introducing the study was: “The aim of the present study is to explore the characteristics of memories of exceptional experiences, i.e. that differ from usual ordinary experiences. This study is entirely anonymous and lasts about 20 min”.

3.1.1. Participants

A total of 472 participants followed the invitation to participate in the study. Of these 389 were deleted because important criteria were violated: premature cancellation (n = 381; 60% of participants stopped following the first page presenting the study), same value entered in psychopathological questionnaire (n = 8). Application of these exclusion criteria reduced the baseline sample to 83 participants who completed all necessary questions. Among them, 55 joined the study via CIRCEE website and 28 via internet platforms of students. The mean age of our participants was 32.1 years (SD = 14.7) the sample comprised 31.3% of men (see Table 4).

Table 4: Socio-demographic characteristics of the participants in Study 2 ($N = 83$)

	<i>M</i>	<i>SD</i>
Age	32.1	(14.7)
Gender	26/57	31.3%
Level of schooling (years)		
RSE	31.1	(6.4)
SCCS	39.1	(10.9)
PDI total score	6.8	(3.9)
PDI preoccupation	16.2	(11.8)
PDI distress	14.4	(11.6)
PDI conviction	22.8	(14.3)

Note: RSE = Rosenberg Self-Esteem scale; SCCS = Self-Concept Clarity Scale; PDI = Peter’s et al Delusion Inventory

3.1.2. Procedure

After giving their online consent to perform the study, participants were first asked to answer questions relating to their age, gender, marital, and vocational status. They were then invited to complete three scales assessing self-esteem, clarity of self-concept and the PDI. As in study 1, participants were asked to retrieve memories cued by means of three categories of cue-words (positive, negative, delusion-like) and for each memory to rate the characteristics of these memories. Finally, at the end of the study, participants were asked about the existence of known psychiatric

diagnoses, psychiatric or psychotherapeutic treatment, and use of current psychotropic medication. Analyses showed that 7 disclosed a history of depression, 5 of Posttraumatic Stress Disorder, 4 disclosed following psychotherapy and 1 taking currently antidepressant and benzodiazepine.

3.1.3. Scales

3.1.3.1. The Self-Concept Clarity Scale (SCCS)

The Self-Concept Clarity Scale (SCCS). This scale (Campbell et al., 1996) assesses the extent to which the contents of an individual's self-concept are clearly and confidently defined, internally consistent, and temporally stable. SCCS consists of 12 items on a 5-point Likert-type scale (with 1 = strongly disagree and 5 = strongly agree) (e.g., "I spend a lot of time wondering about what kind of person I really am" or "My beliefs about myself seem to change very frequently").

3.1.3.2. Rosenberg Self-Esteem (RSE)

This scale (Rosenberg, 1965) is commonly used to assess self-esteem. It comprises 10 items on a 5-point Likert-type scale (with 1 = strongly disagree and 5 = strongly agree), some of them being coded in inverse form.

The order of presentation of SCCS and RSE was randomized.

3.1.3.3. Peters et al. Delusion Inventory (PDI)

This questionnaire was presented above. Importantly, PDI do not contain item relating to clarity of self-concept or self-esteem.

3.1.4. Cueing of memories and rating of memory characteristics

As in study 1, for each items of PDI rated, participants were asked to retrieve one memory related to this experience (see instruction in 2.1.2.3.). Four cue-words (two positive: "surprised", "interested", and two negative: "embarrassed", "alone") from the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986) were also used in order to cue retrieval of positive and negative events. The instruction was for instance: "Please try to remember a past situation in which you have felt embarrassed". The order of presentation of cue-words was randomized. Then, participants were asked to indicate their age at the time of the event and to rate phenomenological characteristics and centrality of each memory using the same rating scales as in study 1 (see 2.1.2.4. and 2.1.2.5.).

3.1.5. Statistical analysis

Similar ANOVAs and correlation analyses were performed as in study 1. PDI total score was used in place of PSYRATS-D to calculate correlation coefficients between delusion proneness (reflected by PDI total score) and other variables in this sample. As explained above on 2.3., planned correlations included also the relationship between SCCS and CES, particularly of delusion-like memories.

3.2. Results

In our sample, 29 participants (34.9%) scored above the PDI cutoff of 8/21.

3.2.1. Phenomenological characteristics and centrality of memories

Significant effects of type of memories were found for age at time of the event, memory vividness, emotional valence and intensity and frequency (all $ps < .024$) but not for the scores of the centrality ($p = .60$) (see Table 5).

Post-hoc analyses revealed that delusion-like memories were rated significantly less detailed than positive ($p = .04$) memories but not than negative memories ($p = .40$).

The valence of delusion-like memories was rather neutral ($M = 3.57/7$, $SD = .20$) and significantly less positive than positive memories and less negative than negative memories (all $ps < .001$).

Emotional intensity of delusion-like memories was significantly lower than that of positive memories ($p = .04$) but did not differ significantly from that of negative memories ($p = .90$).

The frequency of delusion-like memories did not differ significantly from that of positive and negative memories (all $ps > .26$) but positive memories were rated significantly less frequent than negative memories ($p = .03$).

Post-hoc analyses did not reveal significant differences between the mean age at occurrence of the different categories of events.

3.2.2. Correlation and regression analyses

All scores and subscores of PDI were significantly negatively correlated with scores of self-concept clarity ($rs < -0.28$, $ps < .01$) with the exception of conviction subscore ($r = -0.04$, $p = .75$). Thus being higher psychosis proneness was associated with lower self-concept clarity. Interestingly, although the correlation between self-esteem and self-concept clarity was significant ($r = 0.66$, $p < .001$), correlation between PDI scores and self-esteem was significant only with the PDI distress subscore ($r = -0.34$, $p = .002$) and not with total score and other subscore ($rs < 0.20$, $ps > .07$).

Centrality of memories was significantly correlated with emotional intensity and memory vividness in all categories of memories (but the correlation between centrality and vividness was marginally significant for negative memories, see Table 6). Moreover, PDI total score was significantly correlated with vividness of delusion-like memories, with emotional intensity of both negative and delusion-like memories, and with centrality in each category of events. Partial correlations revealed that the correlation between PDI total score and centrality of events remained significant only for delusion-like ($r = 0.34$, $p = .002$) and negative ($r = 0.39$, $p = .001$) memories when vividness and emotional intensity were entered as covariates. Moreover, PDI total score remained significantly correlated with vividness of delusion-like memories when emotional intensity was entered as covariate ($r = 0.27$, $p = .02$).

3.3. Discussion

Results of study 2 confirmed results of study 1 by showing that autobiographical memories of delusion-like experiences are emotionally neutral, less emotionally intense and less vivid than positive memories but do not differ from negative memories. It is worth noting that these results were obtained although positive, negative and delusion-like experiences did not differ according to their frequency of occurrence.

According to our hypotheses, delusion proneness was significantly correlated with a higher propensity for participants to recall vivid and emotionally intense delusion-like memories and to consider them central for their self. As observed in study 1, these correlations were not specific to delusion-like memories as similar patterns of correlations were observed with negative memories.

Finally, self-concept clarity was not significantly correlated with

the centrality of delusion-like and positive memories ($r = - 0.22$, $p = 0.084$ and $r = - 0.24$, $p = 0.059$, respectively) but significantly correlated with the centrality of negative memories ($r = - 0.34$, $p = 0.006$). These correlations were performed after introducing age of participants as covariate as age was significantly and positively correlated with self-concept clarity ($r = 0.48$, $p < 0.001$) (e.g., Bluck & Alea, 2009).

Table 5: Phenomenological characteristics and centrality of positive, negative and delusion-like memories of participants in Study 2

	Positive (P)		Negative (N)		Delusion-like (DL)		<i>F</i>	Statistics η_p^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Age at time of events	26.14	(11.65)	23.77	(10.25)	25.49	(10.64)	3.30 *	0.050 P = N = DL
Vividness (1-7)	5.24	(1.54)	4.91	(1.24)	4.59	(1.61)	3.83 *	0.057 P > DL
Emotional valence (1-7)	5.34	(1.81)	2.64	(1.14)	3.57	(1.58)	52.03 ***	0.452 P > DL > N
Emotional intensity (1-7)	4.43	(1.65)	3.71	(1.34)	3.83	(1.41)	6.12 **	0.088 P > DL,N
Frequency (1-7)	3.30	(1.81)	4.09	(1.75)	3.81	(1.43)	4.28 *	0.064 P < N
Centrality (CES) (1-5)	2.46	(1.00)	2.57	(0.98)	2.60	(0.77)	0.58 ns	0.009 P = N = DL

Note: CES = Centrality of Event Scale

Table 6: Correlation coefficients between memory characteristics and delusion-proneness in participants in Study 2

	Positive				Negative				Delusion-like			
	V	EV	EI	CES	V	EV	EI	CES	V	EV	EI	CES
PDI total	-0.02	0.04	0.17	.250*	0.10	0.08	.264*	.455**	.266*	-0.02	.224*	.416**
Vividness (V)		0.06	0.48***	0.36**		0.18	-0.02	0.22		0.14	0.67***	0.52***
Emotional valence (EV)			0.23	0.06			0.09	0.06			-0.06	0.13
Emotional intensity (EI)				0.52***				0.36***				0.58***

Note: PDI = Peter's et al Delusion Inventory; CES = Centrality of Event Scale

4. General discussion

The present study aimed to examine the relationships between delusions, autobiographical memory and self and particularly whether severity of delusions and delusion-proneness were associated with particular characteristics of memories of delusion-like experiences. Our results obtained with both clinical and nonclinical populations provided converging evidence showing that memories of delusion-like experiences are more vivid, more emotionally intense and considered more central to the self in both people with high delusional proneness and patients diagnosed with schizophrenia with severe delusions.

4.1. Phenomenological characteristics of delusion-like memories

First of all, it is worth noting that in both studies, memories of delusion-like experiences were poorly detailed and associated with neutral and low intense emotions compared to other positive and negative memories (but the difference was not significant between delusion-like and negative memories in both studies). Our results are partially consistent with previous findings by Berna et al. (2014) showing that memories of daily life experiences associated with persecutory content were less distinctive and more schematized than other memories without persecutory content. However, persecutory events were associated with more intense emotions than non-persecutory events, this being due to the high level of anxiety typically associated with persecutory feeling whereas delusion-like experiences examined in our study were likely to include some with milder emotions (for instance: “feeling of being a zombie” item 21, “belief in witchcraft” item 12). Our results are also in contrast with those of two studies conducted with patients with schizophrenia (David & Howard, 1994) and in people without psychiatric diagnosis (Thonnard et al., 2013). These studies showed that both delusional memories memories of a very specific anomalous experience were characterized by higher clarity and higher emotional intensity than other memories used as comparators. This discrepancy may be explained by the methods used to collect both delusion-like and comparative memories in our study and those by David and Howard (1994) and Thonnard et al. (2013). David and Howard (1994) investigated one unique memory directly connected to the core delusions of patients and Thonnard et al. (2013) focused on the memory of this very unique near-death experience sometimes encountered by survivors of cardiac arrest or life-threatening situations (Greyson, 2000). The uniqueness of these memories (that contrasts with the large and heterogeneous set of delusion-like experiences investigated in our study) may explain why both the intensity of emotion and the vividness were particularly high in these studies and not in ours. Moreover, it is worth noting here that in spite of the methodological differences between study 1 and 2 (face-to-face interviews with patients vs. web-based questionnaires with non-clinical population), a similar pattern of results was obtained, this reinforced

our hypothesis that delusion-like experiences memories in general consist in rather poorly detailed memories. Apart from this methodological issue, our results provide new insight on the relationship between memories' characteristics and both delusions proneness and severity. In study 2, delusionproneness was positively correlated with both vividness and emotional intensity of memories of delusion-like experiences and only with emotional intensity (but not vividness) of negative memories. One may thus hypothesize that high delusionproneness activates emotions consonant with individuals beliefs and by so doing, provides easier access to details relating to memories of delusion-like experiences (these memories being in contrast poorly detailed in people with low delusion-proneness). Similar trends were observed in study 1 with patients diagnosed with schizophrenia but the correlation between delusions severity on the one side and emotional intensity and vividness of memories of delusion-like experiences on the other side, did not reach significance level in both cases ($r = 0.44$, $p = 0.08$ and $r = 0.34$, $p = 0.18$, respectively). Lack of statistical power due to limited sample size is likely to explain these non-significant results.

4.2. Centrality to the self of delusion-like memories

Our results showed that memories of delusion-like experiences did not differ significantly from comparative memories with regard to how these memories were considered central to the self. This result was consistent in both studies 1 and 2. Moreover, the centrality of memories of delusion-like experiences correlated significantly with both severity of delusions in study 1 and delusionproneness in study 2. As centrality to the self reflects how particular life experiences have become self-defining or are regarded as turning points in the life, these results suggest that delusion-like experiences exert an increasing influence on the self when delusion-proneness or delusions severity is high. These results are in line with previous studies showing that for some patients, psychotic episodes are key events on which self-representation is built (Berna et al., 2011; Chadwick, 2007; Lysaker et al., 2008). Although motivational or self-serving aspects of delusions (Kesting & Lincoln, 2013; McKay et al., 2007) were not investigated in our study, our results provide new findings illustrating that delusions are intimately linked with the self and more specifically delusional beliefs may alter the relationship between memories of psychotic episodes and self-representation.

However, our interpretation must remain cautious as our correlation analyses prevent us from drawing causal inferences. In fact, one may hypothesize that a delusional self emerges and grounds on delusion-like experiences initially considered as central to the self, but another hypothesis could be that delusion-like experiences have become central to the self following the emergence of delusional beliefs (see Bennouna-Greene et al., 2012; Rathbone, Moulin, & Conway, 2008). Nonetheless, it is worth reminding that significant

positive correlations were also observed between delusion-proneness, delusions severity, and the centrality of negative memories. In other words, the correlation between centrality and delusions was not specific to memories of delusion-like experiences. Negative memories in study 2 referred to past experiences of solitude or embarrassment. According to Berntsen, Rubin, and Siegler (2011), the high centrality of negative memories in participants with high delusion-proneness suggests that they may have a weakened self, lower self-esteem and more negative self-schemas, and according to Kesting and Lincoln (2013), similar conclusions could be applied to patients with schizophrenia in study 1. The significant negative correlation between delusion-proneness and clarity of self-concept (but not with self-esteem) provides some support to this hypothesis and confirms previous results (Berna, G€oritz, et al., 2016; Cicero, Becker, Martin, Docherty, & Kerns, 2013). It suggests that people with low self-concept clarity may be more prone to consider negative and delusion-like experiences as central or self-defining and to integrate these experiences to their self; the reverse interpretation should also be considered, namely that considering negative and delusion-like experiences as central for the self may contribute to weaken the self and reduce self-concept clarity.

4.3. Limitations

We would like to acknowledge some limitations. Firstly, the sample size in study 1 was rather small and the distinct study designs used in our studies prevent us from drawing direct comparisons between patients with schizophrenia and participants in study 2. Secondly, the accuracy of memories of delusion-like experiences could not be checked formerly. The same was true for both positive and negative memories and this limitation is inherent to the vast majority of studies on autobiographical memory (but see (Danion et al., 2005 p.544 for discussion on this point in schizophrenia). Nevertheless, some of our so-called “delusion-like experiences” memories may correspond to truly “delusional memories” or include delusional details in patients examined in study 1. These memories could not be formerly identified and have been integrated in the whole category of memories of delusion-like experiences. Thirdly, the difficulty accessing memory details and retrieving vivid memories in schizophrenia (e.g., Bennouna-Greene et al., 2012; Berna, Potheegadoo, et al., 2016) has been shown to be associated with patients’ impaired executive functioning (Potheegadoo, Cordier, Berna, & Danion, 2014). It remains thus unknown how executive functions and delusions may interact and contribute to poorer access to details of memories of delusion-like experiences. Finally, the population approached by means of this web-based study may differ from people in general population recruited with other methods (Lenhart et al., 2003). We decided upon this option in order to access people with higher propensity to have delusion-like experiences.

4.4. Clinical implications

Our results provide new experimental elements suggesting that delusions are associated with abnormalities in the Self-Memory System. As delusion-like memories are more vivid, more emotional and considered more self-defining in people with high delusion-proneness and patients with severe delusions, these memories may provide confirming evidence to the plausibility of delusional beliefs and consequently to their maintenance over time. In turn, one may hypothesized that the self of individuals with high delusion proneness and in deluded patients with schizophrenia may ground on vivid and emotional memories of delusion-like experiences and lead at its later stage to the emergence of a delusional self.

With regard to the cognitive psychopathology of delusions, our results provide new experimental elements suggesting that delusions are associated with abnormalities in the Self-Memory System (Conway, 2005). As memories of delusion-like experiences are more vivid, more emotional and considered more central to the self in people with high delusion-proneness and in patients with severe delusions, these memories may provide confirming evidence to the plausibility of delusional beliefs and consequently to their maintenance over time. In turn, the self of individuals with high delusion proneness and in deluded patients with schizophrenia may ground on vivid and emotional memories of delusionlike experiences and lead at its later stage to the emergence of a delusional self.

From a therapeutic perspective, it seems important to discuss delusion-like experiences with patients with schizophrenia (or with individuals prone to psychosis) by considering and clarifying their self-significance (for instance, what makes this experience important for the patient and what does it tell him/her about him/ herself). This represents one aspect of a more global metacognitive psychotherapy (Dimaggio, Montano, Popolo, & Salvatore, 2015) aiming to help patients improve mentalization skills and clarify their beliefs about themselves and the world. Moreover, as negative self-schemas are usually associated with delusional beliefs (Kesting & Lincoln, 2013), it is also worth reminding to take self-esteem into account in the psychotherapy of delusions. This aspect is now integrated in the cognitive behavior therapy of positive symptoms and the metacognitive training (Hall & Tarrier, 2003; Moritz, Vitzthum, Randjbar, Veckenstedt, & Woodward, 2010) that both represent efficient and well-accepted treatments for delusions (Eichner & Berna, 2016; Jauhar et al., 2014; Wykes, Steel, Everitt, & Tarrier, 2008).

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