Review

Mapping autobiographical memory in schizophrenia: Clinical implications

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HIGHLIGHTS

- We review the components of autobiographical memory in schizophrenia.
- People with schizophrenia show overgeneral autobiographical memory.
- Trauma functional avoidance could be related with overgenerality in schizophrenia.
- The role of rumination in overgeneral memory is still not clear.
- Autobiographical memory therapies can be used in the treatment of schizophrenia.

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ABSTRACT

Increasing evidence suggests that impaired autobiographical memory (AM) mechanisms may be associated with the onset and maintenance of psychopathology. However, there is not yet a comprehensive review of the components of autobiographical memory in schizophrenic patients. The first aim of this review is a synthesis of evidence about the functioning of AM in schizophrenic patients. The main autobiographical elements reviewed in schizophrenic patients include the study of overgeneral memory (form); self-defining memories (contents); consciousness during the process of retrieval (awareness), and the abnormal early reminiscence bump (distribution). AM impairments have been involved in the clinical diagnosis and prognosis of other psychopathologies, especially depression. The second aim is to examine potential parallels between the mechanisms responsible for the onset and maintenance of disturbed AM in other clinical diagnosis and the mechanisms of disturbed autobiographical memory functioning in schizophrenic patients. Cognitive therapies for schizophrenic patients are increasingly demanded. The third aim is the suggestion of key elements for the adaptation of components of autobiographical recall in cognitive therapies for the treatment of symptoms and consequences of schizophrenia.

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1. Introduction

Autobiographical memory (AM) is the aspect of memory that is concerned with the coherent and integrated recollection of personally experienced past events contributing to an individual's sense of self (Conway, 2005; Williams et al., 2007). As such, disruptions in AM may be implicated in disruptions in sense of self, such as experienced in psychosis. Indeed, relative to normal controls, schizophrenic patients show deficits in binding contextual cues within one memory (e.g. Waters, Maybery, Badcock, & Michie, 2004), in recalling self-referred memories (Harvey, Lee, Horan, Ochsner, & Green, 2011) or in memory source-monitoring (Brébion, Gorman, Malaspina, & Amador, 2005). These are key elements of AM necessary to discriminate between a true recollected experience versus an imagined experience. Breakdowns in cognitive components of autobiographical recollection can therefore potentially produce anomalies of self-experiences such as thought insertion (Klein, German, Cosmides, & Gabriel, 2004) or disturbances in time perception (Bonnot et al., 2011).

A deficient organization of AM in schizophrenic patients may also play an important role in the abnormal development of their personal identity (Bennouna-Greene et al., 2012). Correct functioning of AM is fundamental to avoid the difficulties that schizophrenic patients have in distinguishing between the self and others and in judging whether their thoughts and actions are independent from external influences (Waters & Badcock, 2008). When the processes of autobiographical knowledge acquisition are disrupted, the formation of a coherent stable self-system and identity is truncated (Danion et al., 2005; Neumann, Blairy, Lecompte, & Philippot, 2007). Impairment of AM is proposed as an important factor within such psychopathology (e.g., Elvevag, Kerbs, Malley, Seeley, & Goldberg, 2003; Morise, Berna, & Danion, 2011).

AM disturbances are robustly associated with clinical status of depression and with its recovery process (see Williams et al., 2007, for a review). The diagnosis of depression is often experienced co-morbidly with schizophrenia (Bolton, Gooding, Kapur, Barrowclough, & Tarrier, 2007). Clinically significant depressive symptoms remain stable in chronic schizophrenia (Baynes, Mulholland, Cooper, Montgomery, & MacFlynn, 2000; Buchanan, 2007) and are associated with worse prognosis (e.g., Johnson et al., 2009) and suicide attempts in schizophrenia (Saarinen, Lehtone, & Lönnqvist, 1999). Given growing evidence that the mechanisms involved in AM recall influence prognosis in clinical depression (Williams et al., 2007), such mechanisms may also be relevant to understanding depression in psychosis and to understanding how the patient with schizophrenia perceives and integrates the stressful experiences associated with his/her illness.

Although there is a growing literature analyzing the role of the components of AM in schizophrenia, there is not yet a comprehensive review of the role of autobiographical components within the development of schizophrenia and on the consequences of the illness in patients' lives. Our first aim is therefore to review the components of AM within schizophrenia and other pathologies where AM has been more frequently studied. Key elements of AM examined include: the form of memories, their content, individual awareness, and the distribution of autobiographical memories in schizophrenic patients in comparison to other emotional disorders and to the general population. Finally, directions for the introduction of components of AM training in cognitive therapies to ameliorate symptoms of schizophrenia will be suggested.

The publications analyzed in the current research were obtained after a computerized search of journal articles using as key words the combination of "schizophrenia" and "autobiographical memory "with "depression" or "trauma" or "overgeneral" or "rumination" or "self-defining memories" or "awareness" or "consciousness" or "reminiscence bump" (e.g. "schizophrenia" & "autobiographical memory" & "depression"). In a second step, the word "schizophrenia" was replaced by the word "psychosis" or "delusions" or "hallucinations" or "disordered thoughts" (as representative of positive symptoms) or "blunted affect" or "anhedonia" or "social withdrawal" (as representative of negative symptoms) (e.g., "hallucinations" & "autobiographical memory" & "depression"). The term "schizotypy" was not listed in the search as the current work was focused on people with a diagnosis of schizophrenia. The academic databases consulted were Pubmed ($n = 159$) and PsycInfo ($n = 113$) from the beginning point of each database through July 2015. Abstract screening was carried out independently by J.R. and L.R. In case of disagreement, the full text was read and discussed until conformity was achieved. After database extraction, hand-searching for studies absent from the databases was performed by screening the references of all retrieved articles. Inclusion criteria for the articles in the current research were as follows: a) to be published in an English language peer-reviewed journal, b) to report autobiographical data on schizophrenia disorders, and c) to report information about symptoms of schizophrenia and variables involved in autobiographical recall. There were no inclusion or exclusion criteria for sample size. A total of 78 full texts were finally chosen as central material to construct this article. In addition, for the general description of mechanisms of autobiographical recall and its functioning, articles from personal bibliography of authors were used without following a structured research system.

2. Components of autobiographical memory in schizophrenia

The components of autobiographical memories can be operationalized into a number of elements including: the form they take to summarize the remembered event (how); the contents treated in the description of events (what); the level of self-consciousness

experienced during retrieval, and the temporal distribution through the life of the person who retells his/her past (when). More specifically, the *form* of autobiographical retrieval is the type of response obtained after cueing a participant with words of positive, negative, or neutral valence: "I want you to remember an event that the word happy (sad)... reminds you of" (Williams & Broadbent, 1986). There are two main forms of responses to these cue words: those responses characterized by highly specific sensory-perceptual details that occurred at a particular place and time (specific memories: "the moment of my first kiss") or those responses characterized by more abstract information summarizing repeated events (categoric responses: "every time I saw her in the library").

The *content* of AM is typically examined through examining what people recall when asked for Self-Defining Memories (SDMs), which are memories that help oneself and significant others to understand who one is as a person (Singer & Moffitt, 1992). Such memories are assumed to be representative of other memories that share emotions and themes and associated with the most important concerns and conflicts in an individual's life (e.g. relationships, guilt/shame…) (Blagov & Singer, 2004). As such, SDMs provide an insight into the memory content most related to self-identity.

Degree of *awareness* during the process of autobiographical recall is obtained by examining the recognition of an item as previously learned and the self-appraisal of the level of conviction associated with that recognition. This level of conviction increases when the recognition of the learned item is accompanied by perceptual information present at the moment of learning. Awareness is associated with time perception and contextual binding, which represents when, how and who was involved in the recognized event.

To study the *distribution* of autobiographical memories, patients are instructed to report and date as many memories as possible from their life stories (e.g., Conway, 2005). Samples from the general population recall a larger number of events from the second and third decades of their life than from other periods. This effect is known as the *reminiscence bump* (Rubin, Wetzler, & Nebes, 1986) and contributes to the definition of the self in an integrated and coherent life script (Glück & Bluck, 2007).

2.1. Form: overgeneral autobiographical memories in schizophrenic patients

2.1.1. Definition and background

Overgeneral memory (OGM) has been defined as the recall of memories that are summaries of repeated events (categoric memories) when asked to recall specific memories (Williams et al., 2007). Originally reported by Williams and Broadbent (1986) in suicidal patients, who discovered that in many of their responses, people who had attempted suicide failed to provide specific AMs. OGM has been implicated in the diagnosis and prognosis of several psychopathologies, especially depression and post-traumatic stress disorder (PTSD). The tendency to retrieve overgeneral autobiographical emotional memories is a consistent phenomenon among people with a diagnosis of major depressive disorder (Van Vreeswijk & de Wilde, 2004; Williams et al., 2007). This phenomenon has shown clinical relevance because of its value as a marker of delayed recovery from episodes of affective disorders (e.g., Dalgleish, Spinks, Yiend, & Kuyken, 2001) and as predictor of clinical status at follow-up (Hermans et al., 2008). Coupled with evidence that OGM predicts the onset of later depressive symptoms in individuals who are not currently depressed (Mackinger, Pachinger, Leibetseder, & Fartaceck, 2000), these results have led to its consideration as a trait vulnerability marker for depression (Williams et al., 2007). OGM are also associated with the development of PTSD after trauma (e.g., Kleim & Ehlers, 2008).

2.1.2. Evidence in schizophrenia

OGM is found in schizophrenic patients (see Appendix 1). Patients with schizophrenia retrieved less specific AMs than normal controls

using the Autobiographical Memory Interview (AMI; Kopelman, Wilson, & Baddeley, 1990) and the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986). Across these studies, schizophrenic patients consistently demonstrated lower specificity of AM recall from all periods of life than controls (Baddeley, Thornton, Chua, & McKenna, 1996; Corcoran & Frith, 2003; D'Argembeau, Raffard, & Van der Linden, 2008; Feinstein, Goldberg, Nowlin, & Weinberger, 1998; Riutort, Cuervo, Danion, Peretti, & Salamé, 2003; Wood, Brewin, & McLeod, 2006). The period of early adulthood is the period of life where schizophrenic patients report the lowest number of specific memories (Feinstein et al., 1998; Riutort et al., 2003). Additional studies have compared non-depressed schizophrenic patients, depressed patients, and non-depressed controls. Kaney, Bowen-Jones, and Bentall (1999) found that schizophrenic patients recalled more categoric and extended memories, and less specific memories than patients with major depression and controls. Warren and Haslam (2007) also found greater recall of categoric memories in patients with diagnosis of schizophrenia relative to patients with major depression or controls. Negative symptoms of schizophrenia have been found to be associated with a lack of specificity in AM (Harrison & Fowler, 2004; Raffard, D'Argembeau, Lardi, D'Argembeau, Chanal, Ghisletta, & Van der Linden, 2010) and with rumination (Halari et al., 2009).

These results show that OGM is a consistent effect in patients with depression and schizophrenia. In addition, when depressed patients and schizophrenic patients present similar levels of depression, schizophrenic patients report higher ratings of OGM than depressed patients. These results suggest that OGM in schizophrenic patients may not be only associated with co-morbid depression.

2.1.3. Mechanisms involved in overgeneral autobiographical memory

OGM appears in patients as the result of the activation of cognitive strategies to face adverse situations. Theoretically framed in the CaRFAX model (see Williams et al., 2007, for a review), two main mechanisms of OGM are functional avoidance and rumination.

2.1.3.1. Functional avoidance. Functional avoidance occurs when the recollection of general information instead of specific episodic memories is used to reduce the affective impact of emotional material. This process acting to avoid intense emotional distress is consistently observed in individuals with major depressive disorder (van Vreeswijk & de Wilde, 2004). In the CaRFAX model, it is hypothesized that the OGM can be a consequence of early traumatic events. Children who experience early trauma would adopt a generic style in retrieving AMs as an adaptative affect-regulation strategy (Williams et al., 2007). Accordingly, abused children's memories are more overgeneral and contain more negative self-representations than those of nonmaltreated children (Valentino, Toth, & Cicchetti, 2009).

Similarly, some results suggest that functional avoidance strategy may be acting also in schizophrenic patients in response to traumatic events (Kaney et al., 1999). This hypothesis could be associated with the growing literature showing that early adverse experience is implicated in the aetiology of paranoid symptomatology (e.g., Read, van Os, Morrison, & Ross, 2005; Van Zelst, 2008). Traumatic and aversive experiences and PTSD are common in individuals with psychosis (e.g., Kraan, Velthorst, Smit, de Haan, & van der Gaag, 2015; Morrison, Frame, & Larkin, 2003; Mueser, Rosenberg, Goodman, & Trumbetta, 2002). In addition, the predictive value of overgenerality for depression found in general population is also observed in post-psychosis depression (Iqbal, Birchwood, Hemsley, Jackson, & Morris, 2004). Patients with schizophrenia with previous suicide attempts have an OGM style compared to patients with schizophrenia without previous suicide attempts (Pettersen, Rydningen, Christensen, & Walby, 2010). More specific AM is associated with an increased risk of suicide in non-affective psychosis (Taylor, Gooding, Wood, & Tarrier, 2010). Negative symptoms were found to be significantly associated with avoidance of traumatic memories related to psychosis and hospitalization (Harrison & Fowler, 2004).

The construction of self-images from AM was more passive and less thematically linked in schizophrenic patients than those of controls (Bennouna-Greene et al., 2012). Traumatic events often influence AM and can play an important role in the origin of cognitive dysfunctions associated with delusions (e.g., Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001). Early maladaptive schemas are associated with positive symptoms of schizophrenia (Bortolon, Capdevielle, Boulenger, Gelyy-Nargeot, & Raffard, 2013). The study of AM related to delusional beliefs could be of great interest for furthering our understanding of cognitive bias involved in delusions (Berna et al., 2014).

These results provide indirect evidence about relationship between OGM and the avoidance of remembering traumatic experiences in schizophrenic patients. However, longitudinal prospective studies observing the impact of childhood traumatic events on AM and their association with the development of psychosis are needed.

2.1.3.2. Rumination. The mechanism of *rumination* might also underlie the effect of traumatic events on OGM. Rumination has been defined as repetitive and passive thinking about causes and consequences of one's current mood (Nolen-Hoeksema, 1991). In the CaRFAX model (Williams et al., 2007), rumination "captures" the cognitive self in unprofitable thinking related to conceptual evaluative contents (e.g., "Why do I feel this way?"). Individuals suffering from depression represent a group in whom emotion-related conceptual self-representations or negative self-schemas are highly activated (Williams et al., 2007). When asked to retrieve specific AMs, depressed patients would be trapped in repetitive thinking, probably with self-conceptual negative contents, resulting in difficulties in progressing to the retrieval of the demanded specific AM. Since the formulation of the CaRFAX model, experimental evidence has been accumulated linking rumination with OGM (Barnard, Watkins, & Ramponi, 2006; Watkins & Teasdale, 2004) and depression (Watkins, 2008). Rumination intensifies dysphoric mood and negative thinking (Watkins & Baracaia, 2002). In daily life events, rumination increases the reactivity to negative events in nonclinical samples (Moberly & Watkins, 2008).

Although rumination is a process observed in schizophrenic patients (e.g., Rowland et al., 2013), the association between rumination and OGM in this population has barely been studied. Although Ricarte, Hernández, Latorre, Danion and Berna (2014) found that brooding rumination (a form of maladaptive repetitive thinking) was not associated with schizophrenic patients' difficulty to recall specific memories, this concrete form of rumination was associated with negative symptoms. However, rumination focused on mental illness and is causes and consequences, has been associated with depression in schizophrenic patients (Thomas, Ribaux, & Phillips, 2014), with negative symptoms such as emotional withdrawal (Halari et al., 2009), and with the distress associated with auditory hallucinations (Badcock, Paulik, & Maybery, 2011). Rumination is found to be related to hallucination-proneness only indirectly, through the mediating variable of intrusive thoughts (Jones & Fernyhough, 2009). However, worry, which typically involves repetitive thinking about future potential threats (Watkins, 2008), is involved in the maintenance of persecutory delusions. A brief worry intervention based on psychoeducation and coping about worry produced significant reduction in delusional distress and a trend to reduce the frequency of paranoid thoughts in people with persistent persecutory delusions (Foster, Startup, Potts, & Freeman, 2010). The induction of worry in patients with persecutory delusions increased a range of mild anomalous experiences including feelings of unreality, perceptual alterations, and temporal disintegration (Freeman et al., 2013).

Rumination may be involved in the maintenance of depression in schizophrenia and may ameliorate positive symptoms. However, the role of the interaction between rumination and overgenerality in schizophrenia is still unknown.

2.2. Contents of autobiographical memory: self-defining memories

2.2.1. Definition and background

A self-defining memory (SDM) is a "highly central and significant personal memory that evokes strong emotion and sensory details at the time of recollection. It becomes a repeated touchstone in consciousness that we actively retrieve in certain situations. It is representative of other memories that share its emotions and themes. SDMs revolve around the most important concerns and conflicts in our lives—for example, unrequited loves, sibling rivalries, successes and failures, moments of insight and disillusionment" (Blagov & Singer, 2004, p. 483–484). SDMs have an integrative function because they contain lessons about the self or the world beyond the remembered events (McLean & Thorne, 2003). This integrative quality may indicate that the individual engages in the construction of a life story and uses the past to inform a sense of identity (Blagov & Singer, 2004). SDMs are associated with the pursuit of long-term goals, emotional responses, and dispositional traits (Singer, Rexhaj, & Baddeley, 2007). Emotions and motives derived from SDMs are associated with changes in personality, well-being, and academic performance over the life-course (Sutin & Robins, 2005). SDMs are highly specific per se (e.g., Lardi et al., 2010). Contents of SDMs are also affected by past and present tension and distress in the participant (Blagov & Singer, 2004). That is, memories containing tension can concern an originally past negative event that now is perceived as positive or good, called a *redemption sequence* (McAdams, Reynolds, Lewis, Patten, & Bowman, 2001). The opposite effect in the narrative (going from good to bad) is also possible and is called a *contamination sequence.* Interestingly, the number of redemptive sequences correlate with self-reports of well-being and is found to predict well-being more accurately than the overall emotional valence of the memory (McAdams et al., 2001). Contents and affect of SDMs also show interactions: achievement memories were associated with enhanced positive affect, while life-threatening events produced an increase in negative affect (Blagov & Singer, 2004; Lardi et al., 2010).

SDMs are obtained by asking participants to provide a number of these memories (between 3 and 5) describing their features: vividness, emotionality, repetitive recall, important to an enduring theme, issue or conflict and linkage to other memories (see Blagov & Singer, 2004; Singer et al., 2007). Participants normally report their age at the time of the event, where they were, whom they were with, what happened, and how they and any other person present responded to the event (Raffard et al., 2009; Singer, 2005). After recall, participants are provided with a list of emotions and they are instructed to rate the intensity of those emotions associated with each SDM at the time of recall. Participants are also asked to rate vividness and importance of recalled SDMs. SDMs can be operationalized on four major dimensions: a) structure: narrative specificity; b) content: the principal theme emphasised in the narrative; c) affect: valence and intensity, and d) autobiographical reasoning: self-reflective thinking about past experiences (Blagov & Singer, 2004; Lardi et al., 2010; Singer et al., 2007).

Autobiographical reasoning includes meaning-making statements (lessons learned from the event or insights in the case of meanings that involved a transformation) (McLean & Thorne, 2003), or self-event connections, defined as the relationships between a given experience and one's sense of self (Pasupathi, Mansour, & Brubaker, 2007). The connections between the self and an event can be represented in narratives as a description of personality traits, an attitude about the world, or a description of personal growth and are scored according to nine mutually exclusive categories: intimacy/interpersonal, values, outlook, self-esteem/worth, personal growth, interest, personality, behavior, and role (McLean, Fernandez, Ngan, Smith, & Teebi, 2005).

It has been observed that SDMs have distinctive characteristics in clinical samples with traumatic experiences. Sutherland and Bryant (2005) found that participants with PTSD reported more SDMs that were trauma-related and more from adult years than non-PTSD and control participants. Participants with complicated grief (CG),

compared to participants without CG, provide a distinctive pattern of contents and emotions in SDMs associated with the loved person (Maccallum & Bryant, 2008).

2.2.2. Evidence in schizophrenic patients

SDMs are considered an important means to explore how people with schizophrenia construct their sense of self from AMs (Berna et al., 2011b; Raffard et al., 2009). A number of studies have now focused on the narrative identity and the connectivity of SDMs in schizophrenia (e.g., Berna et al., 2011a; Morise et al., 2011; Raffard, D'Argembeau, Bayard, Boulenger, & Van der Linden, 2010). Across these studies, patients with schizophrenia did not differ from control participants concerning the number of specific SDMs reported (Raffard et al., 2009; Raffard, D'Argembeau, Lardi et al., 2010). However, schizophrenic patients produced fewer meaning-making memories than controls (e.g., Berna et al., 2011a, 2011b). Regarding the contents of the SDMs, the proportion of memories characterized by achievement (one's own or group/family effortful attempts at mastery or accomplishment with regard to physical, material, social, or spiritual goals) was also significantly lower for patients with schizophrenia than controls (Raffard et al., 2009). SDMs characterized by content focused on hospitalization/stigmatization (Raffard et al., 2009), illness (Berna et al., 2011b) and life-threatening events (Raffard, D'Argembeau, Lardi et al., 2010) were recalled significantly more by patients than by controls. Patients also had more SDMs that referred to traumatic events than controls (Berna et al., 2011b). Furthermore, participants with schizophrenia made fewer self-event connections than controls. The proportion of connections characterized by intimacy, values, outlooks, personal growth and self-esteem content was lower for patients with schizophrenia than for controls (Raffard, D'Argembeau, Lardi et al., 2010). The connectivity of AM explained a higher amount of variance of emotional intensity in patients compared with controls. That is, patients grouped their memories according to the emotional experience at retrieval (Morise et al., 2011). Furthermore, in patients with schizophrenia, a decrease in the number of self-event connections was associated with a higher level of negative symptoms (Raffard, D'Argembeau, Lardi et al., 2010) and less richness of future imagined scenes (Raffard, D'Argembeau, Bayard, Boulenger and Van der Linden, 2010).

In summary, it appears that although patients with schizophrenia recall a similar number of SDMs than controls, the contents of their SDMs are more focused on illness, trauma, and stigma. More than impairment in SDMs, schizophrenic patients show a different proportion of themes. In addition, an impoverished connection of AMs is associated with negative symptoms of schizophrenia. The main other difference in the SDMs of patients with schizophrenia relative to controls is in the proportion of meaning-making function and connectivity. Patients appear to extract fewer lessons from past memories and report memories that are less connected to the self.

2.3. Distribution of AM: early reminiscence bump

2.3.1. Definition and background

Based on the premise that healthy individuals encode a fairly equal number of events from each day of life (Elvevag et al., 2003), the idealized life span retrieval curve has been shown to include three main effects: childhood amnesia (0–5 years old), the reminiscence bump (15–30 years old), and the recency effect (most recent 10 years) (see Conway, 2005, for a review). That is, while people have difficulty in recalling memories for events from the first 5 years of life and recall many memories from recent years of their lives, they tend to recall more personal events from the period between the ages of 15 and 30 years (Glück & Bluck, 2007). The period recalled during the reminiscence bump is hypothesized to be a critical period for the formation and maintenance of a stable sense of identity (Conway, 2005). It has been proposed that this reminiscence bump may be a product of the effect of novelty on long-term memory and recognition produced by new

and significant experiences at those ages (Kormi-Nouri, Nilsson, & Ohta, 2005). The periods of adolescence and early adulthood, where the reminiscence bump is observed, are critical for the development and consolidation of goals and self-identity (Conway, 2005). A 4-year longitudinal study with adolescents/emerging adults (aged 16 at first interview) found a significant increase in generative contents in life stories, supporting the meaningfulness of this construct in emerging adulthood (Frensch, Pratt, & Norris, 2007). However, more longitudinal studies are needed to test the different theories elaborated to understand the role of AM in the construction of personal identity in adolescence (Habermas & Bluck, 2000).

The reminiscence bump comprises two components (Holmes & Conway, 1999). An early component concerns memories relating to social identity corresponding mainly to public events that occurred when people were aged between approximately 10 and 19 years old. During this period, individuals may identify with a particular cultural, social, political, or religious group with whom they share common goals and desires. A later component concerns AMs relating to the last stage of personal identity development and corresponding to private events that occurred when the individuals were between the ages of approximately 20 and 29. This is the period when individuals´ goals and desires are to interact with significant others and to form close personal relationships (Conway, 2005). Holmes and Conway (1999) hypothesized that the existential task of the reminiscence bump is the formation of intimate personal relations with others. Consistent with this hypothesis, they found that the highest peak in the reminiscence bump for private events (20–29 years old) corresponded to memories of relationship experiences (marriages, divorces, and other relationships) compared to Birth/Death, Work/Education, Home/Leisure or Illness/Religion.

2.3.2. Evidence for disrupted reminiscence bump in schizophrenia

Using the Autobiographical Memory Inventory (AMI; Kopelman et al., 1990), Feinstein et al. (1998) asked schizophrenic patients and controls to recall specific incidents and autobiographical facts from their childhood, early adulthood, and very recent past (e.g., yesterday). Whereas normal controls exhibited high and equivalent performance in AM across childhood, early adulthood, and recent memories, patients with schizophrenia exhibited a "u-shaped" profile characterized by worst recall of AMs for the early adulthood (after age 18) and for the recent life periods. This generalized decrease in specific AM through different life periods, especially surrounding the time of the onset of the illness, has been replicated (Cuervo-Lombard et al., 2007; Raffard et al., 2009; Raffard, D'Argembeau, Lardi et al., 2010). These studies also reported an abnormal and early reminiscence bump for schizophrenic patients. In the study of Cuervo-Lombard et al. (2007), the reminiscence bump peaked in the 16 to 25-year period for patients and the 21 to 25-year period for controls. Patients exhibited a reminiscence bump peak for events relating to illness in the 21- to 25-year period and a reminiscence bump peak in the 11– to 20-year period for all the remaining event categories (relationship, births/deaths, work/education, home/leisure). The abnormal early reminiscence bump in schizophrenic patients was also related to the relative abundance of memories of public events (local, national or international events relating for instance to wars, murders, politics, sports, or entertainments) during the 10 to 20 years old period, with a predominant impairment of the last stage of personal identity component (20–29 years) concerning AMs of private events (events from their own lives that they considered to be important). Similarly, Raffard et al. (2009) and Raffard, D'Argembeau, Lardi et al. (2010) found that the reminiscence bump peak for control participants was in the 20- to 24-year period, whereas for participants with schizophrenia the reminiscence bump peak was in the 15–19-year period.

The early adult period (after age 18) is the period during which schizophrenia patients generally became ill (Feinstein et al., 1998). It is therefore expected that the onset of schizophrenia produces a disruption in the identity development process with a lower quantity of experiences related to private events in comparison to experiences associated

with public events. Accordingly, before their first episode of illness, schizophrenic subjects had fewer and less satisfactory social relationships than the normal comparison group (Erickson, Beiser, Iacono, Fleming, & Lin, 1989) and private self-focus was more strongly associated with depression and generalized anxiety (Mor & Winquist, 2002).

2.4. Consciousness during retrieval: awareness

2.4.1. Definition and background

The phenomenal subjective experience that accompanies AM can be operationalized in terms of autonoetic (self-knowing) consciousness and noetic (knowing) consciousness (Tulving, 1985). Autonoetic consciousness occurs when the individual mentally reinstates personal experiences of previous events as if reliving them. Noetic consciousness is expressed without any such self-recollection but simply in awareness of familiarity/knowing (Gardiner, 2001). The dimensions of time as reflected in mental time traveling and autonetic consciousness are central to the trans-temporal cohesiveness of self across contexts Markowitsch and Staniloiu (2011)). The capacity to consciously reflect on one's past and navigate through subjective time is critical for a sense of self-continuity and identity (Conway, 2005; Conway & Pleydell-Pearce, 2000). It has been hypothesized that the self, autonoetic consciousness, and AM overlap are connected by their embeddedness in time (Markowitsch & Staniloiu, 2011).

In samples from the general population, the states of awareness might rely on confidence (level of certainty) and conscious control over recollection and familiarity experienced during the process of retrieval (Gardiner, 2001). This state of self-consciousness in retrieval is impaired in clinical samples. Lemogne et al. (2006) found a global AM impairment of positive memories and autonoetic consciousness in a sample of depressed inpatients where psychotic, PTSD, or schizotypal personality diagnosis was excluded. Depressed patients showed lower autonoetic consciousness for positive events than for negative events. Subclinically depressed participants have shown low levels of autonoetic consciousness associated with the recognition of pictorial material (Ramponi, Murphy, Calder, & Barnard, 2010).

Key determinants of autonoetic awareness in schizophrenic patients are contextual binding (information that binds together different aspects of an event) and source monitoring (where, when, and how the event occurred).

2.4.1.1. Contextual binding.
It has been proposed that many of the cognitive deficits observed in schizophrenia result from an observed impairment in the ability to process contextual information (Danion, Rizzo, & Bruant, 1999; Moritz, Woodward, & Ruff, 2003). In addition, patients with schizophrenia might have a deficit in binding together different contextual information to form an intact memory representation. Schizophrenic patients were less accurate than controls in identifying if an action was performed by themselves or if it was watched (participants observed the experimenter pairing objects) (Waters et al., 2004). In addition, correct item recognition was accompanied by simultaneous retrieval of source and temporal information in 75% of controls while in schizophrenic patients this binding was observed in less than the 50% of the correct recognitions.

2.4.1.2. Source monitoring.
Source monitoring refers to the ability to remember the origin of information (Johnson, Hashtroudi, & Lindsay, 1993). In a study of Moritz et al. (2003), schizophrenic and control participants were instructed to provide a semantic association for a list of words. Subsequently, a list was read that contained experimenter- and self-generated words as well as new words, and participants had to identify each item as old/new and name the source. Moritz et al. observed that schizophrenic patients were more biased than controls to believe that the new information was actually initially generated by the experimenter. As a consequence, it has been hypothesized that poor source monitoring may be acting as a vulnerability marker of

positive symptoms of schizophrenia (Keefe, Arnold, Bayen, McEvoy, & Wilson, 2002). Schizophrenic patients have difficulties in distinguishing between imagined-heard, heard, or non-presented words (Brunelin et al., 2007). This difficulty in distinguishing self-generated mental events from perceptions of external events or *noetic agnosia* (Keefe, Arnold, Bayen, & Harvey, 1999) may result in the conclusion that self-generated thoughts come from an external source as experienced in hallucinations and/or delusions. Accordingly, patients with higher hallucinations scores misattributed the items actually produced by themselves more frequently to another source than patients with lower scores in hallucinations (Brébion, Gorman, Amador, Malaspina, & Sharif, 2002). Verbal hallucination proneness in healthy individuals was associated with more intrusions and with an increased tendency to make false recognitions of words (Brébion, Laroi, & Van der Linden, 2010). Individuals scoring high in schizotypy were vulnerable to an increased level of neutral intrusive memories, which may be associated with low information processing in contextual integration (Jones & Steel, 2012).

2.4.2. Evidence in schizophrenia

Different methods have been used to assess past and future autonoetic awareness in schizophrenic patients (see Appendix 2). However, the most frequent method to assess the self-perception of consciousness of retrieval is obtained by training subjects in the "Remember-Know-Guess" procedure (Gardiner, Java, & Richardson-Klavehn, 1996; Tulving, 1985). The participants are instructed to give a "Remember" response when specific aspects of the learning experience are recalled, such as perceptions, thoughts, or feelings that were experienced at the time of the event (autonoetic awareness). A "Know" response is described to participants as simply knowing the specifics of an event (what, where, and when) without conscious recollection of the event (noetic awareness). This method has been complemented with the assessment of "Guess" responses, which corresponds to aspects of the event that are guessed without certainty of occurrence, reflecting a lower level of consciousness than "Know" responses (Danion et al., 2005).

Following this methodology, lower levels of autonoetic consciousness were found in schizophrenic patients in comparison with controls in the recognition of: a) the original source (Danion et al., 1999); b) true or false memories (Huron & Danion, 2002); c) words to-be forgotten (Sonntag et al., 2003) and d) pictures with negative valence (Neumann et al., 2007). Due to the short periods of time elapsed between the learning and the recognition task, the level of consciousness associated with long-term past events was not assessed in these studies. When the level of consciousness was studied in association with the retrieval of AMs, it was found that: a) lower rates of autonoetic consciousness were produced in association with the moment in which the event happened (responses to "when the event occurred?") (Danion et al., 2005), b) specific future events (projection of the self into the future) were generated with lower levels of consciousness in terms of clarity and vividness in patients than in comparison participants (de Oliveira, Cuervo-Lombard, Salamé, & Danion, 2009) and c) true life events collected in diaries were recognized after 2 months with a lower level of consciousness by patients than by controls (Pernot-Marino et al., 2010).

Schizophrenic patients show lower levels of autonoetic consciousness for short- and long-term memories than controls. Most specifically, patients have difficulties in recognising when autobiographical events happened and if they were true or false. This autonoetic impairment is also observed in the generation of high conscious future autobiographical episodes.

3. Clinical implications of autobiographical components in schizophrenia

3.1. Implications of OGM and rumination in schizophrenia

OGM and/or rumination have been associated with disturbances in: a) problem solving (e.g., Maurex et al., 2010; Watkins & Moulds, 2005),

b) imagining the future (e.g., Williams et al., 1996), c) intrusive thoughts (e.g., Brewin, Reynolds, & Tata, 1999; Smets, Luyckx, Wessel, & Raes, 2012) and d) recovery from trauma (e.g., Kleim & Ehlers, 2008). Could OGM and rumination affect those processes in schizophrenic patients?

3.1.1. Problem solving

Depressed or borderline personality disorder patients reporting OGM tend to present difficulties at interpersonal problem-solving tasks (Maurex et al., 2010). Deficits in social performance are present in schizophrenic patients (e.g., Penn, Corrigan, Bentall, Racenstein, & Newman, 1997) even in socially integrated outpatients (Vaskinn, Sundet, Hultman, Friis, & Andreassen, 2009). As in depression, patients with schizophrenia have a significantly poorer means-ends problem-solving procedure (MEPS) performance than controls (Yamashita, Mizuno, Nemoto, & Kashima, 2005). However, impairments in social functioning are one of the most treatment-refractory elements in schizophrenia (Bellack et al., 2007). The fact that specific memory facilitates the recognition of memories that are helpful for problem-solving (Goddard, Dritschel, & Burton, 2001), suggests that training in specific memory recall might ameliorate problem solving skills. Accordingly, Mehl, Rief, Mink, Lüllmann, and Lincoln (2010) found that AM was a better predictor of social performance than psychopathological symptoms and other neurocognitive deficits in patients with schizophrenia-spectrum disorders and suggested that interventions aiming to enhance deficits in AM might improve social performance in these populations. Rumination also reduces the effectiveness of adaptive strategies on problem solving (e.g., Watkins & Baracaia, 2002). Experiential self-focus rumination which involves focusing attention directly on the experience of an event, rather than thinking abstractly or conceptually about the event, is associated with reductions in OGM (Watkins & Teasdale, 2004) and improvements in problem solving (Watkins & Moulds, 2005). Experiential self-focus in schizophrenic patients might reduce OGM and would help to select helpful previous experiences to solve new social situations.

3.1.2. Imagining the future

Depressed individuals and dysphoric individuals who report more OGM show deficits in describing imagined future events (Holmes, Lang, Moulds, & Steele, 2008; Williams et al., 2007). OGM may then also affect the ability to generate future events in schizophrenics patients because it has been demonstrated that they show higher difficulties in imagining specific future events than in retrieving specific past events (D'Argembeau et al., 2008; de Oliveira et al., 2009). Imagining a positive future is important in developing an optimism bias (Sharot, Riccardi, Raio, & Phelps, 2007). Thus, incorporating procedures to encourage the generation of more emotionally vivid prospective positive imagery in schizophrenic patients, as developed for other patient groups (e.g., Holmes, Mathews, Dalgleish, & Mackintosh, 2006) may be valuable.

3.1.3. Intrusive thoughts

OGM may be associated with intrusive thoughts in depression (Brewin et al., 1999). Furthermore, it has been suggested that intrusive memories may develop within psychosis-prone individuals and form the basis of a psychotic episode (Steel, Fowler, & Holmes, 2005). Jones and Steel (2012) found that individuals scoring high in schizotypy were vulnerable to an increased level of intrusive memories, which was suggested to be associated with a pre-existing low level of integration of detailed information from the context. In a later study, these authors also found that schizophrenic patients with a higher level of PTSD symptoms were more vulnerable to neutral intrusive memories than schizophrenic patients with lower level of PTSD symptoms (Jones & Steel, 2014). They suggested that it is possible that a subgroup of psychotic individuals process information in a manner that make them susceptible to frequent intrusive memories characteristics of a PTSD presentation. Ruminative thinking also directly led to an increase in intrusive memories (Smets et al., 2012). So, vulnerability to intrusive thoughts could potentially be reduced by training specificity of contextual information of autobiographical memories and reducing rumination.

3.1.4. Recovery from trauma

Although an association between OGM and trauma is not always a consistent finding (Moore & Zoellner, 2007), the association between traumatic experiences and the presence of psychotic symptoms is hypothesized in integrative models concerning schizophrenia's origin (Howes & Kapur, 2009; Mueser et al., 2002). However, the mechanisms responsible for the association between trauma and psychosis still remain unknown. The contents of psychotic symptoms often relate to past traumatic experiences (Hardy et al., 2005), suggesting the involvement of AM mechanisms. Excessive abstract rumination following traumatic or highly distressing experiences has been proposed to be an important maintaining factor for PTSD symptoms (Santa Maria, Reichert, Hummel, & Ehring, 2012). Reduced memory specificity in assault survivors predicted subsequent PTSD and major depression at 6 months (Kleim & Ehlers, 2008). In addition, rumination partly mediated the effects of low memory specificity on post-trauma psychopathology at follow-up. An impaired ability to retrieve specific memories from one's past may impede the integration of the traumatic experience in the person's schemas about the self and the world (Conway & Pleydell-Pearce, 2000). Based on evidence that OGM is modifiable (Watkins, Teasdale, & Williams, 2000), it has been suggested that training in the accessibility of specific memories may be potentially relevant for trauma survivors with episodes of past depression (Kleim & Ehlers, 2008). Due to comorbidity between PTSD and psychosis (Morrison et al., 2003), the same training in specificity should have positive effects in psychosis.

3.1.5. Reduction of OGM in schizophrenia

OGM may be reduced by training AM specificity in schizophrenic patients (Ricarte, Hernández-Viadel, Latorre, Ros, & Serrano, 2014). Blairy et al. (2008) trained schizophrenic patients in the recall of daily events using diaries. The treatment also included exercises about personal goals, personal identity, self-definition, roles in life and projections on the future. Although this intervention improved the specificity of AM, no effects on depression scores were found. Recently, this same methodology was implemented in combination with the recovery of long-term past personal significant events from childhood, adolescence, adulthood and the last year (Ricarte, Hernández-Viadel, Latorre, & Ros, 2012). In this case, positive significant effects on depression (BDI) scores and consciousness of retrieval were found in the memory training group in comparison with a social skills intervention group for stabilized schizophrenic patients.

Mindfulness-based cognitive therapy (MBCT) has been found to reduce OGM in depressed patients (Williams, Segal, Teasdale, & Soulsby, 2000), non-depressed participants (Heeren, Van Broeck, & Philippot, 2009) and schizophrenic patients (Lalova et al., 2013). According to Wykes, Steel, Everitt, and Tarrier (2008), Cognitive-Behavioural Therapy (CBT) for psychosis has shown a small effect size for the reduction of negative symptoms. This result suggests that CBT may need an adaptation to improve outcomes for the treatment of negative symptoms of schizophrenia. Efforts focused on the reduction of OGM could provide tools for schizophrenic patients to re-elaborate their present and past thoughts and feelings. Accordingly, the number and the richness of emotional details were normalized in schizophrenic patients after a specific cueing method for improving autobiographical memory recall based on the generation of an association between specific autobiographical events occurred during different life periods and a general cue (Potheegadoo, Cordier, Berna, & Danion, 2014).

3.2. Self-defining memories: meaning-making for the self-narrative

Raffard et al. (2009) associated the lack of meaning-making processes in schizophrenic patients with the suppression of the mood-

regulation function that self-defining memories exert in non-clinical samples (e.g., Joormann & Siemer, 2004). This mood-regulation process maintains positive moods and repairs negative moods by retrieving positive memories (Josephson, Singer, & Salovey, 1996). Patients with depression are less able to recall specific SDMs associated with a positive memory (Moffitt, Singer, Nelligan, Carlson, & Vyse, 1994). This lack of mood compensatory use of SDMs was present in schizophrenic patients and may contribute to the persistence of depression in schizophrenia.

From the self-narrative perspective, these findings suggest that life-threatening events may represent a core feature of the sense of self in schizophrenia (Raffard, D'Argembeau, Lardi et al., 2010). This is consistent with the proposal that the content of paranoid beliefs is marked by the idea of being unfairly treated, or of being humiliated in a hostile world (Bentall et al., 2009). The perception of defeat or of being humiliated in a hostile world that accompanies suicidal ideation in schizophrenia might rely in part on the content of patients' autobiographical SDMs (Bolton et al., 2007). The notion of past events of life as something threatening could also bias the patients' social environment appraisal and reduce their motivation in new social interactions (e.g., social withdrawal). Patients with paranoia have a severely affected construction of themselves and their social environment. For example, weaker beliefs in personal justice were significantly associated with more severe symptoms of depression and paranoia as well as with lower scores of psychological well-being (Valiente, Espinosa, Vázquez, Cantero, & Fuentenebro, 2010). Patients with schizophrenia are not skilled in extracting meanings from their personal past events necessary to integrate life-threatening events.

SDMs related to achievement events show more self-event connections of personal growth than other types of SDMs (Lardi et al., 2010). Memories of achievements may help schizophrenic patients to restore negative self-perceptions and increase the construction of positive future images. In fact, negative self-defining events that are perceived as currently resolved produce positive affective effects in the general population. SDMs are more life-threatening in schizophrenic patients suggesting higher presence of unresolved events than in healthy individuals. Autobiographical reasoning could be used to integrate these negative experiences, contributing to the construction of autobiographical coherence (Raffard, D'Argembeau, Lardi, et al., 2010; Singer, 2005). For example, cognitive restructuring (Beck, 1970) referred to the process of learning to challenge one's own inaccurate and/or maladaptive beliefs and then to replace them with more accurate and adaptive ones, needs the use of autobiographical reasoning based on meaning-making processes and can be trained by narrative enhancement. Training with this narrative psychotherapy, where patients share stories and reflect about their role in the stories that they tell and their association with erroneous beliefs about mental illness reduces self-limiting stigmatization (Yanos, Roe, & Lysaker, 2011).

3.3. Early reminiscence bump in schizophrenia: Consequences

The memories from the adolescence and early adulthood that normally occur at the same time as the onset of schizophrenia contribute significantly to the definition of self-identity. The cognitive tools necessaries for the acquisition of global coherence in life story and for the establishment of social-motivational demands of adult life are developed during adolescence (Conway, 2005; Habermas & Bluck, 2000). The experiences of life in schizophrenic patients at that moment are biased by the onset of the symptoms of the disease like blunted affect, social withdrawal, or stereotyped thinking. Accordingly, Corcoran and Frith (1996) observed that schizophrenic patients with negative symptoms did not develop social cognition skills and this lack of social skills produced impairments in their social interaction since childhood.

The development of a coherent life story with more active self-images could enhance outcome and help recovery from psychopathology (Singer, 2005). The elaboration of life story in terms of global coherence,

developed in adolescence in normative population (Habermas & Bluck, 2000), should be specifically intensified in therapy with schizophrenic patients.

3.4. Increasing self-awareness in schizophrenia: when, what and who is remembering?

The development of a coherent and continuous self needs a full awareness of being a rememberer who is remembering and not daydreaming or fantasising (Conway, 2005). "When the process of remembering is acompanied by autonoetic consciousness, the subject is aware of the event as a veridical part of his own past existence" (Tulving, 1985, p. 3). Autonoetic consciousness is also associated with a high presence of sensorial, emotional, and perceptive details that are characteristic of specific AM. This multi-sensorial specificity may help the subject to place himself as present in a concrete moment of his personal life and may offer to him the certainty that he was there and that the event really happened to him. When a schizophrenic patient suffers from low self-consciousness on AM, this integration of the self in a continuos past is disrupted (Danion et al., 2005; Neumann et al., 2007).

In the light of the current results, self-awareness cognitive training, when focused on AMs in schizophrenic patients, might increase efforts to restore memory for context and source monitoring information. Coding systems for autobiographical self-defining memory narratives (theme categories, connectivity of memories with the self, detection sensorial and perceptual elements of the recalled situation) are demonstrating utility for assessment of personality in the service of ongoing treatment (Singer & Bonalume, 2010) and may serve to increase self-consciousness processes in patients. Accordingly, training based on increased detailed description of specific information of significant life experiences, enhanced self-awareness of personal and social events produced after the diagnosis of schizophrenia (Ricarte et al., 2012). The incorporation of training in social cognition (e.g., Roberts & Penn, 2009) based on the attribution of others' mental state and emotions using real autobiographical life situations, could be a practical element of connection between self-conscioussnes of past experiences and future social functioning.

4. Conclusion

4.1. Functioning of autobiographical memory in schizophrenic patients

This review has considered findings from different elements of autobiographical memory in patients with schizophrenia. Impairments in AM have been consistently found in form, contents, awareness and distribution. The most commonly reported characteristic of AM in schizophrenic patients was less AM specificity than normal controls. Defective memories of personal past events have been proposed to be regarded as a major cognitive impairment in this illness (Berna et al., 2015). However, although still scarce, there was also evidence of impairments in contents of AM as assessed by Self-Defining Memories, in their temporal distribution and in their consciousness during retrieval. These components of AM may play an essential role in the characteristic rupture of the self in schizophrenia (Conway, 2005). Further research about these components is needed to understand and try to restore some parts of the personal identity deficits in this illness.

4.2. Mechanisms responsible for the onset and maintenance of disturbed AM in schizophrenic patients

Although originally created to explain overgenerality in depressed patients (Williams et al., 2007), the mechanisms proposed in the CaRFAX model to explain a lack of specificity, seem a valid framework to hypothesize causes of overgenerality in schizophrenia. The association of functional avoidance with trauma, the high presence of traumatic events in life of people with schizophrenia, and the association

between trauma and positive and negative symptoms of schizophrenia, suggest a necessary path of research focused on obtaining a more direct evidence about the links between childhood trauma, AM overgenerality, and symptoms of schizophrenia. Similar autobiographical mechanisms to those found in depression and PTSD look likely to be applicable in schizophrenic patients, consistent with the hypothesis that cognitive processes or mechanisms implicated in psychopathology may occur transdiagnostically (Harvey, Watkins, Mansell, & Shafran, 2004).

Regarding those mechanisms, the role of rumination in schizophrenia is still not well known. In the light of the research reviewed above rumination (higher in schizophrenic patients compared to normal controls) might be more associated with maintenance of depression and positive symptoms than with overgenerality. However, results on rumination and AM in schizophrenia are still only correlational, leaving unresolved the direction of any potential causal relationship. The current lack of experimental or longitudinal prospective tests of these mechanisms in psychosis forces us to be cautious in making any causal inference about the relationships between these mechanisms.

4.3. Autobiographical components in cognitive therapies for schizophrenia

Schizophrenic patients can increase the number of specific memories and decrease depression symptoms after training focused on autobiographical recovery (e.g., Ricarte et al., 2012). However, when those changes in specificity are not accompanied with decreases on rumination, effects on mood state has not been found (Ricarte, Hernández-Viadel, Latorre, Ros and Serrano, 2014). These inconsistent results suggest that we do not possess enough knowledge about mechanisms involved in the association between overgenerality and negative outocomes of schizophrenia such as problem solving, imagining the future, intrusive thoughts and recovery from trauma. The starting hypothesis is that the recovery of specificity would benefit those skills. However, there is still insufficient experimental data contrasting those hypotheses. Preliminary results, depicted in this work, suggest that cognitive mechanisms involved in autobiographical retrieval such us rumination or meaning-making, can be used as a clinical tool in the future to ameliorate mood, symptoms and self-perception in schizophrenia.

Appendix 1

Overgenerality/specificity of autobiographical memories in schizophrenic patients compared with normal controls.

Authorship	Sample	Method of assessment	Results
Baddeley et al. (1996)	5 DP; 5 NDP	AMI	DP: normal performance on specificity; NDP: poorer performance on specificity than DP.
Corcoran and Frith (2003)	59 S; 44 C	AMI	S: worse performing than the control group in childhood, early adult and recent life periods.
D'Argembeau et al. (2008)	16 S; 16 C	Adaptation of AMFCT (10 cue words)	S: Reported less specific and more categoric responses than C; greater number of specific responses for the past task than for the future task. C: No significant differences between past and future tasks.
Feinstein et al. (1998)	19 S; 10 C	AMI	S: U-shaped performance curve (worst performance in the early adult period and best performance in childhood); C: Higher performance than S, remembering an equal amount of material through life periods
Iqbal et al. (2004)	13 PDD 16 nPDD	AMT (10 cue words)	PDD: more general positive memories and negative specific memories and fewer specific positive memories than nPDD.
Neumann et al. (2007)	20 S; 20 C	Recall specific memories evoked by	S: fewer specific memories and negative memories, and more

Appendix 1 (continued)

Authorship	Sample	Method of assessment	Results
Riutort et al. (2003)	24 S; 24 C	pictures from IAPS Adaptation of AMInq	general memories than C. S: Less proportion of specific memories than controls for the periods following the onset of symptoms and no significant differences between periods; C: The proportions of specific memories increased progressively with significant differences between periods
Tamlyn et al. (1992)	60 S; 16 C	AMI	Patients: impaired memory specificity at childhood, early adult life and recently events compared to controls.
Wood et al. (2006)	20 S; 20 C	AMI; AMT (12 cue words)	S recalled fewer specific memories and more categoric memories than C. S: recalled more recent events than events in childhood or early adulthood. C: recalled events did not differ between time periods.

Note: DP = deluded patients; NDP = non-deluded patients; AMI = Autobiographical Memory Interview (Kopelman et al., 1990); S = schizophrenia patients; C = control participants; AMFCT = Autobiographical Memory and Future Cuing Task (Williams et al., 1996); PDD = post-psychotic depression; nPDD = non-post-psychotic depression; AMT = Autobiographical Memory Test (Williams & Broadbent, 1986); AMInq = Autobiographical Memory Inquiry (Borrini et al., 1989); IAPS = Affective Picture System (Lang et al., 1993).

Appendix 2

Synthesis of procedures and results in the assessment of self-consciousness of retrieval for past information in schizophrenic patients.

Authorship	Sample	Method of assessment	Results
Danion et al. (1999)	25 S; 25 C	*Learning task*: Subjects were shown 72 common objects and they had to make pairs with them or to watch the experimenter doing it. *Recognition task:* 45 min later, subjects were presented with a list of 36 pairs of objects, 12 of them were new pairings. *Consciousness appraisal*: Subjects were instructed to make a "remember" or a "know" response.	S: more difficulties in the recognition of the source and higher false recognition of new pairs of words than C; the frequency of autonoetic consciousness decreased especially for observed tasks; the source recognition was most efficient for noetic consciousness situations.
Danion et al. (2005)	22 S; 22 C	*AMT* *Consciousness appraisal:* Participants were instructed to give a Remember, Know or Guess response associated with the recall of what happened, where, and when. *Memory specificity degree*: memories were rated using a five-point scale (0-general information to 4-detailed specific memory)	S: lower rate of "Remember" responses associated with the moment of the event and lower scores in specificity than C.
de Oliveira et al. (2009)	25 S; 23 C	*Future Event Questionnaire:* Participants were asked to describe three plans lasting less than a day concerning next week, next month, next year and the next 5 years. *Consciousness appraisal:* Participants were asked to	S: lower proportion of specific future events and fewer "picture" responses associated with specific future events than C.

Appendix 2 (*continued*)

Authorship	Sample	Method of assessment	Results
		indicate the subjective state of awareness associated with the description of what would happen, where, and when. *Memory specificity degree*: memories were rated using a five-point scale (0-general information to 4-detailed specific memory)	
Huron and Danion (2002)	30 S; 30 C	*Learning task*: Subjects were presented with 24 lists of 16 words (15 words corresponded to the same theme and 1 word was a critical lure). *Recognition task:* 15 min later, subjects were presented 96 items, 32 of which were new words. *Consciousness appraisal*: When subjects recognized the word they had to select a "remember", "know" or "guess" option.	S: Lower recognized number of both studied words and critical lures and lower number of "Remember" responses; the impairment of false memories recognition decreased in the same amount as the recognition of true memories.
Neumann et al. (2007)	20 S; 22 C	*Learning task*: 50 pictures from the IAPS. *Recognition tasks:* 24 h later, 100 pictures from the IAPS, 50 of them were new. *Consciousness appraisal*: Participants were instructed to give a Remember, Know or Guess response after the recognition of the picture.	S: lower recognition rate of pictures with negative valence, higher proportion of "Remember" responses for positve pictures than for negative pictures and lower rate of autobiographical memories of negative valence than C.
Pernot-Marino et al. (2010)	8 S; 8 C	*Autobiographical task*: Diary records over 1 month of two true events, one altered event, and one false event. *Recognition task*: 2 months after completion of the last diary entry, participants were asked to discriminate between true and false diary entries and judge their state of memory awareness as conscious recollection or feeling familiarity. *Consciousness appraisal:* For events judged to be true, the participant was instructed to give a Remember, Know or Guess response.	S: higher number of Know responses associated with true and false memories than C; the frequency of Remember responses was lower for true events and higher for false events; personal importance, distinctiveness and fit-to-plans scores decreased between encoding and retrieval.
Sonntag et al. (2003)	21 S; 21 C	*Learning task*: 48 card-words randomly followed by the instruction "to-be learned" or "to-be forgotten". *Recognition task:* 15 min later, 96 words, 48 of them were distracting words. *Consciousness appraisal:* When subjects recognized the word they had to select a "remember", "know" or "guess" option.	S: higher association between remember responses and words to be learned. Higher proportion of know responses associated with to-be learned word than the proportion of "Know" responses associated with to-be forgotten word. No group differences. The directed forgetting effects were only observed in know responses and were similar in both groups.

Note: S = schizophrenia patients; C = control participants; AMT = Autobiographical Memory Task (Piolino et al., 2003): IAPS = Affective Picture System (Lang et al., 1993).

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