Autobiographical memory in schizophrenia: The role of metacognition

Roberto Mediavilla [a,h,1], Manuel López-Arroyo [b,1], Jorge Gómez-Arnau [c], Courtney Wiesepape [d], Paul H. Lysaker [d,e], Guillermo Lahera [f,g,h,*]

[a] *Department of Psychiatry, Universidad Autónoma de Madrid (UAM), Spain*
[b] *Mental Health Center Guadix, Baza Hospital, Granada, Spain*
[c] *Ramón y Cajal University Hospital, Madrid, Spain*
[d] *Richard L Roudebush VA Medical Center, Department of Psychiatry, Indianapolis, IN, United States*
[e] *Indiana University School of Medicine, Department of Psychiatry, Indianapolis, IN, United States*
[f] *University of Alcala, IRyCIS, Alcala de Henares, Spain*
[g] *Principe de Asturias University Hospital, Alcalá de Henares, Spain*
[h] *Mental Health Networking Biomedical Research Centre (CIBERSAM), Madrid, Spain*

A B S T R A C T

Background: Autobiographical memory is an important component of declarative memory, which refers to the ability to recall personal events that happened in the past. This requires that the person senses or experiences himself/herself in the past (i.e., conscious recollection). For people with schizophrenia, conscious recollection can be particularly difficult, resulting in difficulty accessing detailed, specific autobiographical information. Our hypothesis is that the ability to monitor and think about one's cognitive processes (metacognition) is a requisite for conscious recollection, and that it mediates the association between having schizophrenia and recalling fewer specific, personal memories.

Methods: Participants were 30 adults with schizophrenia and 30 matched healthy controls. The main assessment instruments were the Metacognition Assessment Scale-Abbreviated (MAS-A) and the Autobiographical Memory Test (AMT). Severity of symptoms was assessed using the Positive and Negative Syndrome Scale (PANSS) for schizophrenia. Cognitive performance was measured with the Screen for Cognitive Impairment in Psychiatry (SCIP). Mediation analysis was conducted following Baron and Kenny's procedure.

Results: People with schizophrenia had more semantic associations and fewer specific memories than controls in the AMT. Metacognition (MAS-A total score) partially mediated the association between having schizophrenia and recalling fewer specific past events, even after controlling for cognitive impairment as a potential confounding source.

Conclusions: Metacognitive ability, which can be improved with available programs, intervenes in the process of accessing autobiographical memories in people with schizophrenia. Practical implications of this finding are discussed.

Schizophrenia is a mental disorder with a heterogeneous clinical presentation [1]. Alongside the positive (e.g., hallucinations, delusions) and the negative symptoms (e.g., blunted affect, social withdrawal, etc.), cognitive impairments are commonly present [2], which according to some constitutes the very essence of the disorder [3,4]. Diminished cognitive abilities have been described across different attention tasks [5,6], processing speed tasks [7] and memory tasks, specifically working [8,9], prospective [10], semantic [11] and episodic memory [12,13]. Semantic and episodic knowledge are both part of the declarative memory, but are not equally affected among people with psychosis: they struggle more with context-dependent, sensory-perceptual information (i.e., episodic knowledge) [14], than they do with more abstract mental

representations (i.e., semantic knowledge). When the knowledge that is difficult to access is that which contains relevant information about one's past experiences, a specific type of memory is affected, namely autobiographical memory.

Autobiographical memory (AM) contains different types of knowledge that refer to the person and persist over time [15]. Like declarative memories, autobiographical memories can either be conceptual and with higher levels of abstraction (semantic AM), or linked to sensory-perceptual stimuli, which entails a sense of mental "time travel" during retrieval (episodic AM) [16–19]. They complement each other because specific memories about one's experiences need to be integrated into more complex autobiographical knowledge structures to last more

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than just hours or days. Thus, when the person remembers, it is important that he or she sense himself or herself in the past, a phenomenon called recollective experience [18,20]. Re-experiencing oneself in the past improves the quality of AM in that it elicits more details and helps to place specific memories in a timeline [21]. It also serves a further purpose by helping "ground the self" by promoting the construction of self-knowledge (i.e., autonoetic consciousness) and self-narratives [15,22,23].

People with schizophrenia show AM impairments to a similar degree as deficits in other memory systems [24]. In a meta-analysis, Berna and colleagues narrowed this deficit in AM to three areas: retrieval of specific past events, richness of detail, and conscious recollection (i.e. the sense of being oneself in the past). They also reviewed the factors that could account for such deficit and reported that previous research focused on depression symptoms, history of childhood trauma, negative symptoms, and specific cognitive abilities, such as executive functions or general retrieval capacities. However, their conclusion was that the available empirical data did not consistently support any of these factors as underlying mechanisms of the AM deficit in schizophrenia.

A cognitive process that might partially explain why people with schizophrenia have difficulty retrieving past events is metacognition. Metacognition refers to the awareness of affective, cognitive and embodied experiences and the ability to integrate them into a broader multifaceted self [25]. When someone is asked to recall context-related episodic information (e.g., who came to my 8th birthday party), the person needs to activate the so-called "retrieval mode," which is similar to the sense of "time travel" mentioned above. This retrieval mode allows the person to access specific memories due to a multilevel cognitive process that relies on specific (meta)memory strategies (e.g., sorting birthday parties from childhood and selecting the specific 8-year-old party) [15,26] and also on broader metacognitive abilities, such as maintaining a decentered sense of self (e.g., discarding memories of somebody else's birthday parties) or carefully monitoring the retrieval process (e.g., noticing when fuzzy episodic memories are completed with semantic knowledge). Mounting evidence supports the deficit in specific metamemory strategies [27,28] and broad metacognitive abilities [29,30] in people with schizophrenia. In this study, we test the hypothesis that global metacognitive deficits in schizophrenia, characterized by impaired monitoring of cognitive processes or lack of self-reflection about ones' own, mediates the association between having schizophrenia and recalling less specific autobiographical memories.

1. Method

1.1. Study design and participants

Sixty participants were included in the study: 30 outpatients, diagnosed with schizophrenia according to DSM-5 [31], and 30 healthy controls matched with the former for age, sex, place of residence and educational level. The diagnosis of the patients was confirmed with the Structured Clinical Interview for DSM-5 (SCID-5). All the patients were stable, defined by the absence of hospital admissions or medication changes in the previous 3 months, and receiving pharmacological treatment with antipsychotics. Patients were excluded from the study if they had: 1) a diagnosis of psychosis due to medical illness or substance use, 2) a history of traumatic brain injury, 3) neurological disease, 4) severe visual impairment or 5) any medical condition that could affect their cognitive performance. Control subjects had no current psychiatric diagnosis according to DSM-5. Likewise, they were not taking psychiatric medication or undergoing outpatient treatment of any type. The dosage of the antipsychotic medication was converted by Leucht's method of olanzapine equivalents [32].

1.2. Instruments

Metacognitive Assessment Interview (MAI) [33]. This is a semi-structured clinical interview designed to elicit and evaluate the metacognitive abilities of the participant in a brief narrative of a psychologically significant experience or event. The metacognitive functions assessed by the MAI are monitoring, integration, differentiation, and decentering. In the context of the interview, the patient is asked to describe the most disturbing experience of the previous 6 months. This time frame was selected to facilitate recall. Once the description of the episode is completed, the interviewer asks a series of questions to elicit and evaluate each metacognitive subfunction.

Metacognition Assessment Scale-Abbreviated (MAS-A) [34], Spanish version [35]. This instrument is an adaptation of the Metacognition Assessment Scale (MAS) [36], that quantifies the metacognitive skills implied from the interviewee's verbal responses. It consists of four subscales: 1) 'Understanding of One's Mind / Self-Reflectivity', which includes ten levels on the ability to think and form increasingly plausible, complex, and integrated ideas of oneself; 2) 'Awareness of the Mind of the Other / Differentiation', which consists of eight levels on the ability to think and form increasingly complex and plausible ideas about others; 3) 'Decentration', made up of four levels that measure one's awareness of the of lives of members of their larger community and their place within that community; and 4) 'Mastery', which includes ten levels on the ability to use metacognitive knowledge about oneself and others to address psychological and social problems. A final, aggregated score is also obtained. The higher the scores, the greater the ability to integrate and use intersubjective information effectively. Data obtained to date with the American version of the MAS-A suggest that internal consistency as well as test-retest and interrater reliability are acceptable, with intraclass correlation coefficients between 0.71 and 0.91 [34,37]. As for its construct validity, the MAS-A scores significantly correlate with other tests that measure awareness of illness, cognitive insight, social schema complexity, and preference for active coping strategies in people with psychosis [38].

Autobiographical Memory Test (AMT) [39], Spanish version [40]. This test assesses the specificity of autobiographical memory. Patients are provided with a 15-page booklet. On each page there is a written keyword and they are asked to write a specific memory that each keyword evokes. Previously, it is explained that a specific memory must refer to a particular event or situation that occurred at a specific time and place on a specific day. In addition, the evoked memory must be different for each keyword and must be at least one week old. At the beginning of the task, 12 keywords (5 with positive valence, 5 with negative valence and 2 neutral) are presented alternately. Both the instructions and the different keywords are read by the interviewer. If after 60 s of pronouncing the keyword the subject does not write a memory, the test goes on to the next word. The resulting memories are categorized according to their degree of specificity. Thus, memories of events lasting less than 24 h are coded as specific (AMT-Specific). If the event lasts more than 24 h, it is coded as extended (AMT-Extended). If the memory occurs repeatedly at different times, it is coded as categoric (AMT-Categoric). When there is no answer, or the reported event is repeated, it is coded as omission (AMT-Omissions). And finally, when the patient verbalizes an association that does not mention an event (usually names of people, animals or objects), that is classified as semantic association (AMT-Semantic).

Screen for Cognitive Impairment in Psychiatry (SCIP) [41], Spanish version [42]. The SCIP is a clinician-administered instrument that assesses cognitive functioning using five subscales: Working Memory Test, Verbal Learning Test-Immediate, Verbal Learning Test-Delayed, Verbal Fluency Test and Processing Speed Test. The test gives an operational result in four categories: normal performance, mild, moderate, or severe cognitive impairment.

Positive and Negative Syndrome Scale (PANSS) [43], Spanish version [44]. The PANSS is a test that evaluates the severity of the symptoms of schizophrenia through three subscales: Positive Symptoms, Negative Symptoms and General Psychopathology.

1.3. Procedure

Patients who met the inclusion criteria were briefly interviewed by telephone and asked to freely sign an informed consent, previously approved by the local Ethics Review Board. If they agreed, an in-person interview was scheduled. After signing the informed consent form, clinical and psychosocial data were collected. After this, the PANSS, SCIP, and AMT were administered consecutively. The tests applied to the healthy controls were the same, except for the PANSS, as it is a psychopathological evaluation scale. All the interviews were carried out by the same researcher, previously trained for the administration of the scales. The audio of all the interviews was recorded for later transcription and quantification with MAS-A.

1.4. Data analysis

First, variables were described in terms of frequencies or in terms of means, medians and standard deviations, depending on their distribution. To test if interval variables fit a Gaussian distribution, the Shapiro-Wilk test was conducted. Differences between groups were estimated using the Fisher's exact test for categorical variables, the chi-squared test for ordinal variables, and the t-test or the Mann-Whitney's test for continuous variables. Then, we performed a mediation analysis following Baron and Kenny's procedure [45] to test the hypothesis that metacognitive abilities mediated the association between having schizophrenia and recalling less specific memories in the AMT. This procedure consists of conducting a series of regression analyses to obtain different effect estimators (i.e., regression coefficients). First, we estimated the effect of having schizophrenia (our exposure) on the number of specific autobiographic memories recalled by the participant (our outcome), as measured by the AMT Specific subscale score, and represented by c. Then, we estimated the effect of having schizophrenia on overall metacognition (our mediator), as measured by the MAS-A Total score, and represented by a. Third, we estimated the effect of metacognitive abilities on autobiographical memory (a). Last, we estimated the effect of having schizophrenia on autobiographical memory *controlling for* the effect of metacognition (c'). Every estimator was also adjusted for the presence of cognitive impairment, as measured by the SCIP. The 95% confidence intervals for the average causal mediation effect (ACME) was calculated using a bootstrapping sampling procedure with 1000 simulations. A post-hoc, exploratory analysis was done following the same procedure, but including the scores of the MAS-A subscale Self-Reflectivity as a mediator, instead of the MAS-A total score.

2. Results

The characteristics of the participants are displayed in Table 1. The groups did not differ in terms of age, gender, or educational level, but people with schizophrenia were less likely to be employed or married and presented with a worse cognitive performance.

Regarding autobiographical memory, people with schizophrenia had fewer specific memories ($W = 664$, $p = 0.001$) and more semantic

Table 1
Characteristics of the participants.

	Group			Test	p
	Schizophrenia (n = 30)	Control (n = 30)	All (n = 60)		
Age in years, *M (SD)*	35.17 (8.67)	36.57 (6.51)	35.87 (7.63)	$t(58) = -0.707$	0.482
Gender, *n (%)*				OR = 0.51[a]	0.295
Women	10 (33)	15 (50)	25 (42)		
Men	20 (67)	15 (50)	35 (58)		
Educational level[b]				$\chi^2(3) = 0.58$	0.901
Primary (not completed)	3 (10)	2(7)	5 (8)		
Primary (completed)	17 (57)	19(66)	36 (61)		
Secondary	8 (27)	6(21)	14 (24)		
University	2 (7)	2(7)	4 (7)		
Marital status[b]				$\chi^2(3) = 10.209$	0.017
Single	28 (97)	19(63)	47 (80)		
Married	1 (3)	7(23)	8 (14)		
Divorced	0	3(10)	3 (5)		
Widowed	0	1(3)	1 (2)		
Employment[b]				$\chi^2(3) = 13.157$	0.004
Studying	2 (7)	6 (20)	8 (14)		
Employed	3 (10)	10 (33)	13 (22)		
Unemployed	14 (48)	13 (43)	27 (46)		
Retired	10 (35)	1 (3)	11 (19)		
Cognitive impairment (SCIP)				$\chi^2(3) = 11.425$	0.010
Absent	3 (10)	14 (47)	17 (28)		
Mild	9 (30)	8 (27)	17 (28)		
Moderate	7 (23)	2 (7)	9 (15)		
Severe	11 (37)	6 (20)	17 (28)		
Duration of schizophrenia in years, *M*	13.50				
Olanzapine-equivalent neuroleptic dosage in mg, *M (range)*	10.8 (±4.1)				
PANSS, *M (SD)*					
Positive syndrome	16.90 (4.72)				
Negative syndrome	17.13 (5.89)				
General psychopathology	31.67 (7.84)				
MAS-A					
Self	5.10 (1.81)	6.93 (1.42)	6.02 (1.86)	W = 709	<0.001
Others	3.92 (1.70)	5.15 (1.57)	4.53 (1.74)	W = 639.5	0.005
Decentration	1.38 (0.54)	1.73 (0.58)	1.56 (0.58)	W = 609	0.015
Mastery	4.80 (1.67)	6.37 (1.46)	5.58 (1.74)	W = 692.5	<0.001
Total	15.20 (5.33)	20.18 (4.84)	17.69 (5.49)	$t(58) = 3.919$	<0.001

Note. SCIP = Screening for Cognitive Impairment in Psychiatry, PANSS = Positive and Negative Syndrome Scale, MAS-A = Metacognitive Assessment Scale – Abbreviated.

[a] Fischer's exact test.

[b] N = 59.

associations ($W = 279.5$, $p = 0.012$) than controls on the AMT. Additionally, controls had higher overall metacognitive abilities ($t = 3.919$, $df = 58$, $p < 0.001$) and performed better on every subscale of the MAS-A ($W > 609.00$, $p < 0.015$). These results can be seen in Fig. 1.

Fig. 2 shows that the effect of having schizophrenia on autobiographical memory ($c = -1.8$, 95% CI from -3.3 to -0.3) decreases when overall metacognition is included in the model as a mediator ($c' = -1.1$, 95% CI from -2.6 to 0.5, non-significant), showing that the association between having schizophrenia and recalling fewer specific autobiographical memories was mediated by metacognition (ACME $= -0.7$, 95% CI from -1.3 to -0.1). Similar results were obtained using Self-reflectivity (a MAS-A subscale), instead of MAS-A total score, as a mediator (ACME $= -0.6$, 95% CI: -0.1, 1.2). Because the dependent variable (number of specific memories on the AMT) was negatively skewed, analyses were conducted over the cube-rooted AMT-Specific score, with similar results. Association (Pearson correlation coefficients) between AMT and MAS-A domains are presented in Supplementary Table 1.

3. Discussion

Our results demonstrated that people with schizophrenia recall fewer specific autobiographical memories (AMs) and make more semantic associations than controls without schizophrenia. These results are consistent with previous reviews and meta-analyses [23,24], and support the hypothesis that people with psychosis tend to remember general, abstract information, instead of specific personal experiences. Our results also showed that the association between having schizophrenia and recalling fewer specific past events during a memory task is partially

explained (i.e., mediated) by metacognitive deficits, as measured by a multilevel metacognitive task, even after controlling for a potential confounding source, namely neurocognitive impairment. This is in line with previous evidence suggesting that metacognitive abilities may be linked to AM, as the cortical areas responsible for both processes often overlap [46]. However, to the best of our knowledge, ours is the first study that explores such association empirically. Mediation analysis is a statistical method used to quantify the causal sequence by which an antecedent variable causes a mediating variable that causes a dependent variable. In this case, our study shows that the association of having schizophrenia and AM impairment is mediated by a deficient metacognition.

These findings could add some knowledge to the exploration of the cognitive mechanisms accounting for AM impairment in schizophrenia. In order to understand the role of metacognition as a mediator variable, it is important to conceptualize the two stages that AM entails, namely the generation of the specific autobiographical memory in the past (encoding) and the access to that memory in the present (retrieval). The accessibility and availability of a certain specific memory is influenced by how, where and when it was codified. However, the retrieval stage has received more attention, perhaps because it can be modified in the present time. Recently, Berna and colleagues offered preliminary evidence that people with psychosis are overconfident about their performance during an AM task [47], a metacognitive deficit usually detected in schizophrenia with non-autobiographical memory tasks [27,28]. Specifically, Berna and colleagues asked their participants to judge whether a certain event was part of a series of autobiographical memories that they had reported previously to the examiner (that is, a hit) or if it was not (false alarm). The authors had previously found that people
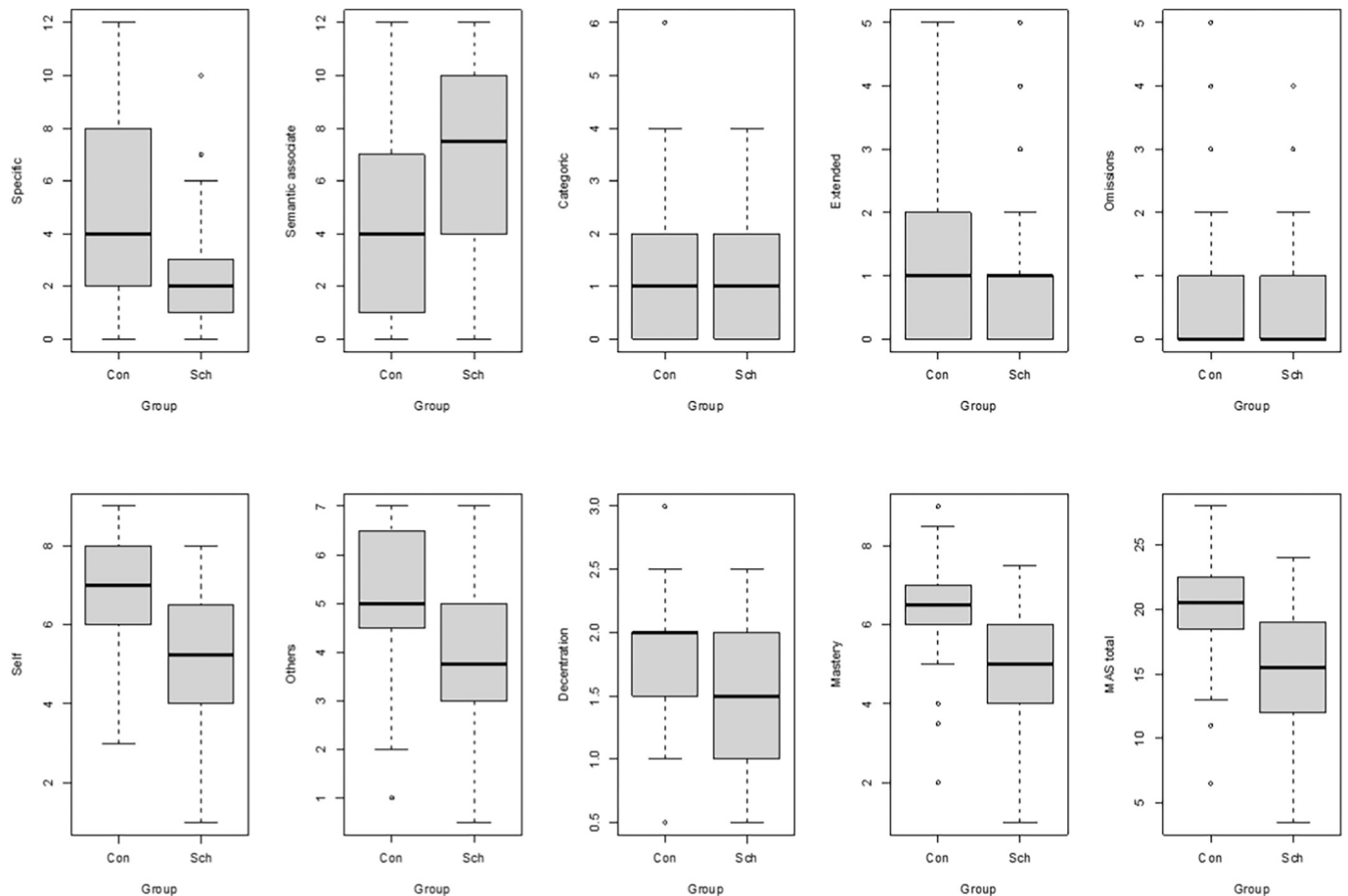

Fig. 1. Box-and-whiskers plots showing both the frequency of the five categories of the Autobiographic Memory Test (AMT) (upper row) and the mean of the four subscales and the total score of the Metacognitive Assessment Scale - Abbreviated (MAS-A) (lower row).
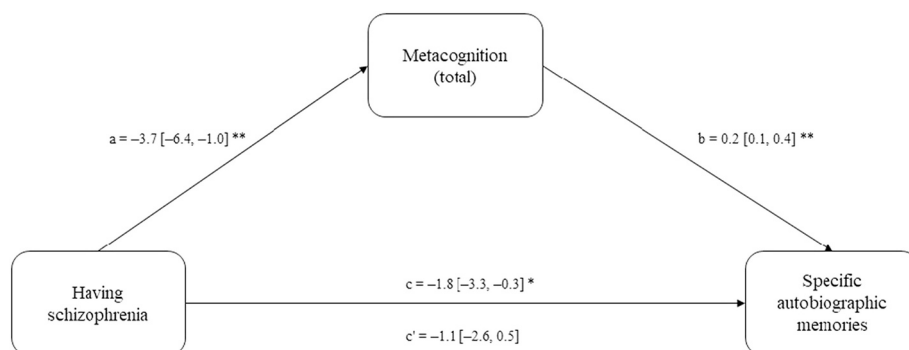
Fig. 2. Regression coefficients (beta) and 95% confidence intervals (in square brackets), where *a* refers to the effect of having schizophrenia over metacognition (MAS-A), *b* is the effect of MAS-A on specific autobiographical memories recall (AMT-Specific), *c'* is the effect of having schizophrenia over AMT-Specific, and *c* is the effect of having schizophrenia controlling for MAS-A scores. All estimators are adjusted for neurocognitive impairment. (*$p < 0.05$, **$p < 0.01$).

with schizophrenia displayed a signal detection similar to that of people without schizophrenia [48]. Yet, what they found later was that, when people with schizophrenia misidentified a false alarm as a hit, they were more confident than controls on their judgments [47].

The study design of Berna and colleagues was different from ours. In fact, their between-groups analyses revealed similar results on AM, likely because they used a recognition task and we used a recall task. However, one can imagine how metacognition can impact the retrieving process during a recall task. If the person has trouble trying to recall a certain specific event that happened to him or her in the past, he or she might think that the memory (or perhaps the event) is simply not there. At that point, being overconfident on that memory not being available would automatically make the person conclude the searching process, which will result in a worse performance. The aberrant autobiographical metamemory - over-confidence about false judgments and under-confidence in correct responses - may be explained by a deficient monitoring of cognitive processes or lack of self-reflection during the experience of these past events. The retrieval of personal memories needs a previous integration of the affective, cognitive, and embodied experiences into a broader multifaceted self. This could explain why patients with schizophrenia show specific difficulty recalling events encoded from a first-person perspective [49].

Accessing specific autobiographical memories requires a descriptive, fine-grained recollective experience, which consists of experiencing himself or herself in the past, when encoding took place [18]. Thus, retrieving a specific autobiographical memory is not an automatized process, such as recalling the capital of France or a personal address; it is a complex activity that requires complex mental activities which allow for the integration of thought, emotion and embodied experience into a broader sense of self and others. That conscious recollection is what distinguishes *remembering* a personal event from just *knowing* or *guessing* that it happened [18,50], and it requires for monitoring processes to be put in place – potentially metacognitive abilities that are affected in schizophrenia.

The practical implications of these results are worth outlining. First, we know that people with schizophrenia can improve their meta-cognitive abilities after short, group interventions [51–54] as well as individual integrative psychotherapy [55]. It can be expected that such interventions would influence AM as well. Second, it has been proposed that the AM deficit in schizophrenia is part of a coping strategy to avoid distressing or even traumatic past experiences [23,56,57]. If so, increasing the ability to monitor the retrieval process in a safe environment might help to elaborate traumatic memories that otherwise would remain dissociated. However, the current evidence supporting that AM deficit in schizophrenia relates to coping strategy of traumatic events is still limited. The last implication refers to a related but broader aspect, namely the construction of the self. People with schizophrenia have problems even with the most basic levels of selfhood, such as the

so-called minimal self or ipseity [58,59]. This is linked to more specific impairments, such as the belief that certain experiences, either tangible or mental, are not one's own (sense of ownership) [60,61]. As Klein and colleagues proposed, when the process of recollecting past personal experiences is affected, the disintegration of self might occur [62]. In sum, increasing metacognition in schizophrenia could help with monitoring the retrieval of autobiographical memories, facilitating the access to more detailed, context-related information, and therefore providing more events in which selfhood can be grounded.

This study has certain limitations. First, non-probabilistic sampling methods were used, so it is not possible to generalize the results. However, sociodemographic and clinical characteristics are provided to facilitate the comparison of the results with other studies. Second, metacognition abilities were assessed by a self-reported instrument, so the possibility of biased responses cannot be rejected. Third, neither the Spanish version of the AMT nor the Spanish version of the MAS-A have been tested through well-designed psychometric studies. Last, the sample was rather small, so more complex mediation analyses could not be performed. Metacognition overlaps with neurocognitive functions such as memory, attention, and executive function, and a metanalysis reported a small to moderate mean effect size between neurocognition and metacognition [63]. However, in this study, general cognitive abilities, a possible confounder factor in the model, were statistically controlled for.

In conclusion, this study provides evidence that metacognition plays an important role in the process of retrieving autobiographical memories. This has theoretical implications in terms of understanding the mechanisms of conscious recollection and self-construction and practical implications regarding the use of the available metacognitive interventions for reducing AM deficits. Further research is needed in both directions.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.comppsych.2021.152254.

References

[1] Owen MJ, Sawa A, Mortensen PB. Schizophrenia. Lancet 2016;388:86–97. https://doi.org/10.1016/S0140-6736(15)01121-6.
[2] Heinrichs RW. The primacy of cognition in schizophrenia. Am Psychol 2005;60: 229–42. https://doi.org/10.1037/0003-066X.60.3.229.
[3] Elvevag B, Goldberg TE. Cognitive impairment in schizophrenia is the core of the disorder. CRN 2000;14. https://doi.org/10.1615/CritRevNeurobiol.v14.i1.10.
[4] Kahn RS, Keefe RSE. Schizophrenia is a cognitive illness: time for a change in focus. JAMA Psychiat 2013;70:1107–12. https://doi.org/10.1001/jamapsychiatry.2013.155.
[5] Luck SJ, Hahn B, Leonard CJ, Gold JM. The hyperfocusing hypothesis: a new account of cognitive dysfunction in schizophrenia. Schizophr Bull 2019;45: 991–1000. https://doi.org/10.1093/schbul/sbz063.

[6] Luck SJ, Gold JM. The construct of attention in schizophrenia. Biol Psychiatry 2008;64:34–9. https://doi.org/10.1016/j.biopsych.2008.02.014.

[7] Knowles EEM, David AS, Reichenberg A. Processing speed deficits in schizophrenia: reexamining the evidence. AJP 2010;167:828–35. https://doi.org/10.1176/appi.ajp.2010.09070937.

[8] Forbes NF, Carrick LA, McIntosh AM, Lawrie SM. Working memory in schizophrenia: a meta-analysis. Psychol Med 2009;39:889–905. https://doi.org/10.1017/S0033291708004558.

[9] Lee J, Park S. Working memory impairments in schizophrenia: a meta-analysis. J Abnorm Psychol 2005;114:599–611. https://doi.org/10.1037/0021-843X.114.4.599.

[10] Wang Y, Chan RCK, Shum DHK. Schizophrenia and prospective memory impairments: a review. Clin Neuropsychol 2018;32:836–57. https://doi.org/10.1080/13854046.2017.1406144.

[11] Doughty OJ, Done DJ. Is semantic memory impaired in schizophrenia? A systematic review and meta-analysis of 91 studies. Cogn Neuropsychiatry 2009;14:473–509. https://doi.org/10.1080/13546800903073291.

[12] Guo JY, Ragland JD, Carter CS. Memory and cognition in schizophrenia. Mol Psychiatry 2019;24:633–42. https://doi.org/10.1038/s41380-018-0231-1.

[13] Leavitt VM, Goldberg TE. Episodic memory in schizophrenia. Neuropsychol Rev 2009;19:312–23. https://doi.org/10.1007/s11065-009-9107-0.

[14] Baddeley A, Thornton A, Chua SE, McKenna P. Schizophrenic delusions and the construction of autobiographical memory. In: Rubin DC, editor. Remembering our past: studies in autobiographical memory. Cambridge: Cambridge University Press; 1996. p. 384–428. https://doi.org/10.1017/CBO9780511527913.016.

[15] Conway MA. Sensory–perceptual episodic memory and its context: autobiographical memory. Phil Trans R Soc Lond B 2001;356:1375–84. https://doi.org/10.1098/rstb.2001.0940.

[16] Conway MA, Williams HL. 2.46 - Autobiographical memory. In: Byrne JH, editor. Learning and memory: a comprehensive reference. Oxford: Academic Press; 2008. p. 893–909. https://doi.org/10.1016/B978-012370509-9.00135-2.

[17] Thomsen DK. There is more to life stories than memories. Memory 2009;17:445–57. https://doi.org/10.1080/09658210902740878.

[18] Tulving E. Memory and consciousness. Can Psychol 1985;26:1–12. https://doi.org/10.1037/h0080017.

[19] Tulving E. Episodic memory: from mind to brain. Annu Rev Psychol 2002;53:1–25. https://doi.org/10.1146/annurev.psych.53.100901.135114.

[20] Gardiner JM. Functional aspects of recollective experience. Mem Cognit 1988;16:309–13. https://doi.org/10.3758/BF03197041.

[21] Morise C, Berna F, Danion J-M. The organization of autobiographical memory in patients with schizophrenia. Schizophr Res 2011;128:156–60. https://doi.org/10.1016/j.schres.2011.02.008.

[22] Hazan H, Reese EJ, Linscott RJ. Narrative self and high risk for schizophrenia: remembering the past and imagining the future. Memory 2019;27:1214–23. https://doi.org/10.1080/09658211.2019.1642919.

[23] Ricarte JJ, Ros L, Latorre JM, Watkins E. Mapping autobiographical memory in schizophrenia: clinical implications. Clin Psychol Rev 2017;51:96–108. https://doi.org/10.1016/j.cpr.2016.11.004.

[24] Berna F, Potheegadoo J, Aouadi I, Ricarte JJ, Allé MC, Coutelle R, et al. A meta-analysis of autobiographical memory studies in schizophrenia spectrum disorder. Schizophr Bull 2016;42:56–66. https://doi.org/10.1093/schbul/sbv099.

[25] Lysaker PH, Kukla M, Vohs JL, Schnakenberg Martin AM, Buck KD, Hasson Ohayon I. Metacognition and recovery in schizophrenia: from research to the development of metacognitive reflection and insight therapy. J Exp Psychopathol 2019;10. https://doi.org/10.1177/2043808718814992. 2043808718814992.

[26] DeMarie D, Ferron J. Capacity, strategies, and metamemory: tests of a three-factor model of memory development. J Exp Child Psychol 2003;84:167–93. https://doi.org/10.1016/S0022-0965(03)00004-3.

[27] Moritz S, Woodward TS, Jelinek L, Klinge R. Memory and metamemory in schizophrenia: a liberal acceptance account of psychosis. Psychol Med 2008;38:825–32. https://doi.org/10.1017/S0033291707002553.

[28] Moritz S, Woodward TS. The contribution of metamemory deficits to schizophrenia. J Abnorm Psychol 2006;115:15–25. https://doi.org/10.1037/0021-843X.15.1.15.

[29] Lysaker PH, Vohs JL, Ballard R, Fogley R, Salvatore G, Popolo R, et al. Metacognition, self-reflection and recovery in schizophrenia. Fut Neurol 2012;8:103–15. https://doi.org/10.2217/fnl.12.78.

[30] Sellers R, Wells A, Morrison AP. Are experiences of psychosis associated with unhelpful metacognitive coping strategies? A systematic review of the evidence. Clin Psychol Psychother 2018;25:31–49. https://doi.org/10.1002/cpp.2132.

[31] American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-5®). American Psychiatric Pub; 2013.

[32] Leucht S, Samara M, Heres S, Patel MX, Furukawa T, Cipriani A, et al. Dose equivalents for second-generation antipsychotic drugs: the classical mean dose method. Schizophr Bull 2015;41:1397–402. https://doi.org/10.1093/schbul/sbv037.

[33] Semerari A, Cucchi M, Dimaggio G, Cavadini D, Carcione A, Battelli V, et al. The development of the metacognition assessment interview: instrument description, factor structure and reliability in a non-clinical sample. Psychiatry Res 2012;200:890–5. https://doi.org/10.1016/j.psychres.2012.07.015.

[34] Lysaker PH, Carcione A, Dimaggio G, Johannesen JK, Nicolò G, Procacci M, et al. Metacognition amidst narratives of self and illness in schizophrenia: associations with neurocognition, symptoms, insight and quality of life. Acta Psychiatr Scand 2005;112:64–71. https://doi.org/10.1111/j.1600-0447.2005.00514.x.

[35] Lysaker PH, Buck K, Hamm J. Escala de evaluación de la metacognición: una breve visión general y manual de codificación para la versión abreviada (EEM-A) v 2015. Rev GPU 2016;12:174–90.

[36] Semerari A, Carcione A, Dimaggio G, Falcone M, Nicolò G, Procacci M, et al. How to evaluate metacognitive functioning in psychotherapy? The metacognition assessment scale and its applications. Clin Psychol Psychother 2003;10:238–61. https://doi.org/10.1002/cpp.362.

[37] Lysaker PH, Salyers MP. Anxiety symptoms in schizophrenia spectrum disorders: associations with social function, positive and negative symptoms, hope and trauma history. Acta Psychiatr Scand 2007;116:290–8. https://doi.org/10.1111/j.1600-0447.2007.01067.x.

[38] Lysaker PH, Vohs J, Minor KS, Irarrázaval L, Leonhardt B, Hamm JA, et al. Metacognitive deficits in schizophrenia: presence and associations with psychosocial outcomes. J Nerv Ment Dis 2015;203:530–6. https://doi.org/10.1097/NMD.0000000000000323.

[39] Williams JM, Broadbent K. Autobiographical memory in suicide attempters. J Abnorm Psychol 1986;95:144–9. https://doi.org/10.1037//0021-843x.95.2.144.

[40] Ricarte JJ, Latorre JM, Ros L. Diseño y análisis del funcionamiento del Test de Memoria Autobiográfica en población española. Apuntes Psicol 2013;31:3–10.

[41] Purdon SE, Purdon SE. The screen for cognitive impairment in psychiatry (SCIP): administration manual and normative data2005. Edmonton: Alberta: PNL Inc; 2005.

[42] Pino O, Guilera G, Rojo JE, Gómez-Benito J, Bernardo M, Crespo-Facorro B, et al. Spanish version of the screen for cognitive impairment in psychiatry (SCIP-S): psychometric properties of a brief scale for cognitive evaluation in schizophrenia. Schizophr Res 2008;99:139–48. https://doi.org/10.1016/j.schres.2007.09.012.

[43] Kay SR, Fiszbein A, Opler LA. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr Bull 1987;13:261–76. https://doi.org/10.1093/schbul/13.2.261.

[44] Kay SR, Fiszbein A, Vital-Herne M, Fuentes LS. The positive and negative syndrome scale—Spanish adaptation. J Nerv Ment Dis 1990;178:510–7. https://doi.org/10.1097/00005053-199008000-00007.

[45] Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Pers Soc Psychol 1986;57:1173–82.

[46] Dimaggio G, Salvatore G, Popolo R, Lysaker PH. Autobiographical memory and mentalizing impairment in personality disorders and schizophrenia: clinical and research implications. Front Psychol 2012;3:529. https://doi.org/10.3389/fpsyg.2012.00529.

[47] Berna F, Zou F, Danion J-M, Kwok SC. Overconfidence in false autobiographical memories in patients with schizophrenia. Psychiatry Res 2019;279:374–5. https://doi.org/10.1016/j.psychres.2018.12.063.

[48] Berna F, Huron C, Kazès M, Offerlin-Meyer I, Willard D, Verry P, et al. Chronic persecutory delusion and autobiographical memories in patients with schizophrenia: a diary study. Israel J Psychiatry Rel Sci 2014;51:25–33.

[49] Kwok SC, Xu X, Duan W, Wang X, Tang Y, Allé MC, et al. Autobiographical and episodic memory deficits in schizophrenia: a narrative review and proposed agenda for research. Clin Psychol Rev 2021;83:101956. https://doi.org/10.1016/j.cpr.2020.101956.

[50] Danion J-M, Cuervo C, Piolino P, Huron C, Riutort M, Peretti CS, et al. Conscious recollection in autobiographical memory: an investigation in schizophrenia. Conscious Cogn 2005;14:535–47. https://doi.org/10.1016/j.concog.2005.01.005.

[51] Eichner C, Berna F. Acceptance and efficacy of metacognitive training (MCT) on positive symptoms and delusions in patients with schizophrenia: a meta-analysis taking into account important moderators. Schizophr Bull 2016;42:952–62. https://doi.org/10.1093/schbul/sbv225.

[52] Favrod J, Rexhaj S, Bardy S, Ferrari P, Hayoz C, Moritz S, et al. Sustained antipsychotic effect of metacognitive training in psychosis: a randomized-controlled study. Eur Psychiatry 2014;29:275–81. https://doi.org/10.1016/j.eurpsy.2013.08.003.

[53] Ochoa S, López-Carrilero R, Barrigón ML, Pousa E, Barajas A, Lorente-Rovira E, et al. Randomized control trial to assess the efficacy of metacognitive training compared with a psycho-educational group in people with a recent-onset psychosis. Psychol Med 2017;47:1573–84. https://doi.org/10.1017/S0033291716003421.

[54] van Oosterhout B, Krabbendam L, de Boer K, Ferwerda J, van der Helm M, Stant AD, et al. Metacognitive group training for schizophrenia spectrum patients with delusions: a randomized controlled trial. Psychol Med 2014;44:3025–35. https://doi.org/10.1017/S0033291714000555.

[55] Lysaker PH, Keane JE, Culleton SP, Lundin NB. Schizophrenia, recovery and the self: an introduction to the special issue on metacognition. Schizophrenia Res 2020;19:100167. https://doi.org/10.1016/j.scog.2019.100167.

[56] Barry TJ, Del Rey F, Ricarte JJ. Valence-related impairments in the retrieval of specific autobiographical memories amongst patients with schizophrenia. Br J Clin Psychol 2019;58:140–53. https://doi.org/10.1111/bjc.12205.

[57] Harrison CL, Fowler D. Negative symptoms, trauma, and autobiographical memory: an investigation of individuals recovering from psychosis. J Nerv Ment Dis 2004;192:745–53. https://doi.org/10.1097/01.nmd.0000144693.12282.11.

[58] Nelson B, Parnas J, Sass LA. Disturbance of minimal self (Ipseity) in schizophrenia: clarification and current status. Schizophr Bull 2014;40:479–82. https://doi.org/10.1093/schbul/sbu034.

[59] Sass LA, Parnas J. Schizophrenia, consciousness, and the self. Schizophr Bull 2003;29:427–44. https://doi.org/10.1093/oxfordjournals.schbul.a007017.

[60] Ferri F, Costantini M, Salone A, Di Iorio G, Martinotti G, Chiarelli A, et al. Upcoming tactile events and body ownership in schizophrenia. Schizophr Res 2014;152:51–7. https://doi.org/10.1016/j.schres.2013.06.026.

[61] Humpston CS, Broome MR. Thinking, believing, and hallucinating self in schizophrenia. Lancet Psychiatry 2020;0. https://doi.org/10.1016/S2215-0366(20)30007-9.

[62] Klein SB, German TP, Cosmides L, Gabriel R. A theory of autobiographical memory: necessary components and disorders resulting from their loss. Soc Cognit 2004;22: 460–90. https://doi.org/10.1521/soco.22.5.460.50765.

[63] Davies G, Greenwood K. A meta-analytic review of the relationship between neurocognition, metacognition and functional outcome in schizophrenia. J Ment Health 2020;29:496–505. https://doi.org/10.1080/09638237.2018.1521930.