Self-continuity across time in schizophrenia: An exploration of phenomenological and narrative continuity in the past and future

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Abstract

Background: Disorders of the self, such as a reduced sense of personal continuity in time, are a core symptom of schizophrenia, but one that is still poorly understood. In the present study, we investigated two complementary aspects of self-continuity, namely *phenomenological* and *narrative continuity*, in 27 patients with schizophrenia, and compared them with 27 control participants.
Methods: Participants were asked to identify important past events and to narrate a story from their life that included these events. They were also asked to imagine important events that might happen in their personal future and to build a narrative of their future life. The vividness of these important life events and the proportion of self-event connections in the narratives were used as a measure of *phenomenological* and *narrative continuity*, respectively.
Results: Our study showed patients with schizophrenia experienced less vivid representations of personally significant events (p = .02) for both temporal directions (past and future) (p < .001). In addition, their ability to make explicit connections between personal events and self-attributes in life narratives was also impaired (p = .03), but only in the case of past narratives (p < .001).
Conclusions: These results shed new light on the cognitive mechanisms underlying self-disorders in schizophrenia. The clinical and therapeutic implications of these findings are discussed.
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1. Introduction

Disorders of the self are a core and frequent symptom of schizophrenia [1–4] and probably one of its most intriguing features. Such disorders manifest themselves through a broad range of anomalous self-experiences [2,5,6], one of them being a reduced sense of personal continuity, also described as a fragmentation of the self in time. Several theoretical and empirical models [3,7] have been put forward in an attempt to understand the putative causes of these disorders, which are still poorly understood.

Recent theoretical and empirical work in the field of autobiographical memory and narrative research suggests that self-continuity involves at least two distinct components [8,9]. The first component, *phenomenological continuity*, is the experience of self-continuity that is felt through mental time travel, either when mentally re-living past events or when pre-experiencing events that might happen in the future [10–12]. Mental time travel results in the perception that the present moment is both a continuation of the past and a prelude to the future [13]. It also contributes to the subjective feeling that both past and future selves belong to a unique self in the present. Neuroimaging studies have shown that re-experiencing past events and pre-experiencing future events recruit a common set of brain regions (for a recent meta-analysis; see Ref. [14]), and some of these regions have consistently been associated with self-processing [15], lending support to the view that past and future mental time travel may contribute to the experience of self-continuity across time.

The second aspect of self-continuity, *narrative continuity* [9], is the sense of personal continuity that arises from the

creation of coherent life stories. In this regard, memories of personal events have to be integrated into a coherent life story in order to create narrative continuity [16–18], which involves autobiographical reasoning processes, such as self-event connections that serve to establish links between personal past events and self-attributes (for instance, "that journey changed many things for me; I understood what is meant by the meaning of life, and since then I am more self-confident"; "When I came back to Vietnam, I realized that in the meantime I had grown away from my own culture") [19,20]. In this way, an individual can integrate several, sometimes disparate, aspects of his or her self and reconcile the many selves present over time to produce a continuous and coherent self-view [17,21,22].

The idea that phenomenological and narrative continuity are two distinct processes, both contributing to self-continuity, is supported by neuroimaging findings showing that re-experiencing past events and reasoning on their implications for the self recruit distinct brain networks [23]. Existing literature on autobiographical reasoning and self-event connections has focused almost exclusively on self-narratives of past events, but the seminal work by d'Argembeau and collaborators [24] suggests that the ability to reflect on the potential implications of important future events (i.e. self-defining future projections) involves similar processes as those at play when extracting personal meaning from past self-defining events.

Several previous studies have investigated these two aspects of self-continuity in patients with schizophrenia. Some studies provided evidence for an impaired phenomenological continuity, showing that patients had a reduced capacity to re-experience past events [25–28] and to pre-experience future events [29–32]. Other studies yielded preliminary evidence for a damaged narrative continuity [33], showing that patients were impaired in extracting personal meaning from important past events [34–37] and anticipated future events [32]. Importantly, however, none of these previous studies explored the relationship between phenomenological and narrative continuity in schizophrenia. Furthermore, a direct comparison of these two dimensions of self-continuity between the past and the future remains to be performed. The present study aimed to address these issues by investigating both aspects of self-continuity in both temporal directions (past and future), thus allowing for a better identification of the different dimensions that could underlie the reduced sense of self-continuity that characterizes patients with schizophrenia.

2. Materials and methods

2.1. Participants

Twenty-seven stabilized outpatients (11 women) were recruited from the Psychiatric Department of Strasbourg's University Hospital. All of them fulfilled the DSM-IV-TR diagnosis of schizophrenia [38]. Patients experiencing a major depressive episode (score higher than 6 on the Calgary Depression Scale for Schizophrenia (CDSS) [39]), and those with an IQ of less than 70 (WAIS-R, [40]) were excluded. All but one of the patients were receiving antipsychotics for at least one year (first generation, $n = 22$; second generation, $n = 2$; both, $n = 2$). Nine patients were being treated with benzodiazepines and 4 with antiparkinson medication. The control group consisted of 27 healthy participants (11 women). This study was part of a larger study on the life stories of patients with schizophrenia [34]. The present analyses were carried out on the 25 patients included in this study for whom data were available for the narratives of both past and future events. Two additional patients were also recruited. The control group consisted of all the controls from the previous study and one additional participant. There was no current substance abuse among either patients or controls and none of them had a history of traumatic brain injury, epilepsy, or other neurological disorders. There were no significant differences between our groups in terms of age, level of education, or IQ.

The IRB of Lille III approved this study, and all of the experiments were conducted in accordance with the latest version of the Declaration of Helsinki. All the participants gave their informed written consent once the nature of the procedures had been fully explained to them.

2.2. Clinical and neuropsychological evaluation

Symptom severity of schizophrenia in patients was assessed using the Positive And Negative Syndrome Scale [41]. All patients were clinically assessed for depression with the help of the Calgary Depression Scale for Schizophrenia, and controls completed the Beck Depression Inventory [42]. Participants' anxiety level and self-esteem were assessed using the State–Trait Anxiety Inventory (STAI, [43]) and Rosenberg Self-Esteem scale (RSE, [44]) respectively.

Executive functioning, particularly mental flexibility and strategic retrieval of information from memory, was assessed with (1) the Trail-Making Test (Part A and B, [45]) and (2) semantic and phonological verbal fluency tasks [46], respectively. We selected executive functions deemed to play a particular role in both autobiographical reasoning abilities and the retrieval of detailed memories [29,35,47]. See Table 1.

2.3. Task and procedure

Patients and controls were asked to think about the 7 most important events they experienced personally in the past, and to narrate a story of their life including those 7 events. The exact instructions were as follows: "First, I'd like to ask you to think about the seven most important events that happened in your life. These may be events that just happened, or events that happened a long time ago. Please write your seven most important memories on these seven cards. Please name only memories of very specific events. Next, I'd like you to tell me a story involving your whole life. Please think about all the events that happened in your life since you were

Table 1

Demographic, clinical and neuropsychological data of patients with schizophrenia and control participants.

	Patients (n = 27)		Controls (n = 27)		Statistics	
	M	(SD)	M	(SD)	t	p
Demographic data						
Age	35.55	(9.04)	34,00	(9.63)	−0.62	.54
Years of schooling	12.96	(2.34)	12.89	(2.36)	−0.12	.91
f-NART[a] (premorbid IQ[b])	107.08	(8.66)	108.65	(4.74)	0.80	.43
Current IQ	96.39	(13.74)	99.85	(8.56)	1.07	.29
Clinical measures						
BDI[c]	–	–	2.96	(3.38)		
[d]	1.67	(1.68)	–	–		
STAI-YA[e]	48.10	(7.08)	42.42	(7.08)	−2.58	.01
STAI-YB[f]	50.84	(7.48)	38.92	(7.48)	−5.04	<.001
RSE[g]	29.51	(3.90)	34.70	(3.90)	4.78	<.001
Age at illness onset (years)	22.12	(5.81)	–	–		
Duration of illness (years)	12.96	(8.43)	–	–		
PANSS[h] (total score)	65.59	(18.80)	–	–		
Positive symptoms	15.96	(5.28)	–	–		
Negative symptoms	18.48	(6.53)	–	–		
General symptoms	31.15	(10.02)	–	–		
Neuropsychological measures						
TMT[a] shifting score (B-A)	−0.29	(0.87)	−0.07	(1.22)	0.73	.47
Verbal fluency (z-score)	−0.12	(0.96)	0.70	(0.68)	3.23	.002

[a]Trail-Making Test, [b]Intelligence Quotient, [c]Beck Depression Inventory, [d]Calgary Depression Scale for Schizophrenia, [e]State–Trait Anxiety Inventory manual; part A assessing state anxiety, [f]State–Trait Anxiety Inventory manual; part B assessing trait anxiety, [g]Rosenberg Self-Esteem Scale, [h]Positive and Negative Syndrome Scale.

born, and integrate the seven events into your story. For example, you can tell me about the most important events in your life and the biggest changes. You can also explain to me how these events are still important to you today and how they have influenced the kind of person you are today. Please take about 15–20 minutes to tell your story. I won't interrupt you. There is no right or wrong answer."

The same procedure was applied to the future, the only difference being that participants were asked to imagine 3 important events that could happen in their personal future and to construct a narrative of their future life based on these events: "Now, I'd like you to think about three possible future events; they could be events that you know will happen or events you would like to happen. These events could happen either in a near or a distant future. Please name only very specific events and write them on these three cards. Afterwards, I'd like to ask you to narrate a story of your future life in which you integrate the three future events you were thinking of. By means of this story, I'd like to understand who you will become in the future. Please take about 5 minutes to tell your story, I won't interrupt you. There is no right or wrong answer."

It was decided to ask for only 3 important future events given that we felt it would be difficult for patients to imagine 7 important events. All patients and controls completed the task on past events first, followed by the task on future events.

2.4. Subjective ratings of memories and future thoughts

After narrating their past and future life stories, participants were asked to date the 7 memories and to estimate the time of the imagined future events. They also rated the vividness and emotional valence of each mental representation (memories and future thoughts) on 7-point scales [48], with 1 = "My mental representation is vague" and 7 = "My mental representation is very detailed" for vividness, and 1 = "My feelings associated with the mental representation are negative" and 7 = "My feelings associated with the mental representation are positive" for emotional valence. Vividness was used as an index of phenomenological continuity, since it is a dimension of event representation which is easily understandable for patients and which has been shown to be strongly correlated with the subjective feeling of re-experiencing past events [49] and pre-experiencing future events [24].

Finally, participants completed the short version of the Centrality of Event Scale [50], assessing the extent to which each of the 7 memories had become a reference point for their personal identity or a turning point in their life. An adaptation of this scale was used to assess the potential influence of the three future events on the narrator's identity[1].

2.5. Scoring of narratives

After producing a verbatim transcription of participants' stories, we counted the number of events included in each past and future narrative. An event was defined as a focus on

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[1] Item 6 of the CES was not converted into a future form because its wording was not well suited to the future. Consequently, for the sake of making consistent comparisons between the past and future, Item 6 of the CES of past events was also removed from the analysis.

Table 2
Characteristics of mental representations of past and future events and of past and future life narratives in patients with schizophrenia and control participants.

	Patients (n = 27)				Controls (n = 27)				Statistics					
	Past		Future		Past		Future		Group		Time		Interaction	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)	F(1,51)	p	F(1,51)	p	F(1,51)	p
Subjective ratings of memories														
Temporal distance (years)	17.94	(10.67)	3.14	(3.78)	13.83	(8,84)	5.00	(6.39)	0.03	.87	318.85	<.001	2.05	.16
Memory vividness (1 to 7)	5.37	(1.03)	3.85	(1.45)	5.91	(1.00)	4.39	(1.45)	5.33	.02	41.05	<.001	0.00	.99
Emotional valence (1 to 7)	4.20	(1.56)	5.30	(1.33)	4.97	(1.40)	6.22	(0.74)	11.31	.001	22.67	<.001	0.09	.76
Centrality (1 to 5)	3.57	(0.82)	3.67	(0.64)	3.73	(0.79)	3.86	(0.76)	1.24	.27	0.71	.40	0.02	.88
Parameters of the narratives														
Number of events	13.92	(4.46)	3.96	(1.34)	15.30	(5.31)	4.11	(1.42)	1.49	0.23	230.86	<.001	1.01	.32
Index of self-event connections*	0.40	(0.33)	0.27	(0.38)	0.80	(0.62)	0.30	(0.28)	4.78	0.03	15.20	.003	7.07	.01
Index of references to past in the narrative of the future*	–	–	0.32	(0.31)	–	–	0.32	(0.34)	0.02	.89	–	–	–	–

*Number of occurrence/number of events in the narratives.

a single action, which had a clear beginning or end, was limited in time, and could be located in space (e.g., "then we decided to move to Nice", "At the age of 35, I started my new job near the Champs Elysées"). When a global action was split into several smaller actions, only one event was counted. Three independent coders segmented all past and future narratives and obtained good reliability (Cronbach's α = 0.78) for the number of events contained in the narratives. Any disagreements were resolved by discussion.

Self-event connections were counted each time narratives mentioned either identity changes (such as behavioral or personality changes) or self-event connections reflecting the stability of identity (e.g. "I've always been a shy person and had difficulty making friends") [51,52]. Two independent coders rated all past and future narratives (past: κ = 0.71; future: κ = 0.69), and any disagreements were resolved by discussion.

Finally, given that inserting a reference to past events in the future narrative may also contribute to self-continuity across time, the number of spontaneous references to past events in the future narratives was counted for each participant (α = 0.94).

2.6. Statistical analyses

Data were analyzed using analyses of variance (ANO-VAs), with group (patients vs. controls) as a between-subject factor and temporal orientation (past vs. future) as a within-subject factor. For each participant, the mean score of rating scales or narrative components for past and future mental representations was used.

3. Results

3.1. Subjective ratings of memories and future thoughts

Because participants reported 7 past events and 3 future events, only the first 3 past events given by the participants were included in the following analyses in order to ensure a better comparison between past and future events. The results are shown in Table 2. As can be seen, the temporal distance of future events was significantly lower than the distance of past events. There was no difference in temporal distance across groups, and the interaction between group and temporal orientation was not significant. The vividness of mental representations was significantly lower in patients than controls and significantly lower for future events than past events; the interaction was not significant. With regard to emotional valence, the patients' mental representations were less positive than those of controls but were still positive overall, with a mean score of 4.2/7. Mental representations of the future were significantly more positive than those of the past; the interaction between group and temporal direction was not significant. With regard to the centrality of events, there was no significant effect of group or temporal direction, and no interaction.

3.2. Contents of the narratives

Future narratives contained significantly fewer events than past narratives (Table 2); there was no effect of group or interaction [2]. Given that the number of self-event connections may vary depending on the number of events included in the narratives, we decided to divide the number of self-event connections by the number of events in each narrative. The index of self-event connections was significantly lower in patients' than in controls' narratives, and was significantly lower in future than past narratives. The interaction between group and temporal direction was also significant. Post-hoc analyses revealed a significant difference between the past and the future for the index of self-event connections in the control group (p < .001) but not in patients (p = .40), and a significant group difference for past narratives (p < .001), but not for future narratives (p = .91). A similar method was

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[2] Participants were instructed to choose 7 past events and 3 future events but were then free to include as many events as they wished in their past and future narratives. Therefore, analyzing the number of events included in past and future narratives was considered to be informative.

Table 3
Correlation analyses between the characteristics of past and future events in patients with schizophrenia and control participants.

Controls upper Patients lower		Past events/narratives			
		Details	Valence	Centrality	Self-event connections
Future events/narratives	Details	**r = 0.34/p = .08** r = −0.33/p = .10			
	Valence		**r = 0.17/p = .40** r = −0.40/p = .85		
	Centrality			**r = 0.33/p = .0.9** r = 0.18/p = .36	
	Self-event connection				**r = 0.44/p = .02** r = 0.13/p = .52

used to calculate an index of references to past events in the future narratives. Results showed no significant difference between patients and controls.

3.3. Correlation analyses

We started by examining whether the phenomenological and narrative continuity scores were correlated to each other. The correlations between the index of self-event connections and vividness ratings were not significant in either group for either past or future narratives (rs < 0.20, ps > .31). Then, we examined the correlation between the past and future self-continuity scores (see Table 3). No significant correlation emerged between the vividness ratings of past and future events in either patients or controls. On the other hand, a positive correlation was observed in both groups between the index of self-event connections in the past and future narratives; this correlation was statistically significant only in the control group, however. Finally, in patients, no significant correlation was found between measures of self-continuity (the subjective vividness of events and index of self-event connections), on the one hand, and measures of executive function, self-esteem or symptoms of illness, on the other hand.

4. Discussion

This study showed that two critical and complementary aspects of self-continuity, namely phenomenological and narrative continuity, are impaired in patients with schizophrenia. The difficulty of patients in constructing vivid representations of personally significant events (thought to reflect phenomenological continuity) was observed for both temporal directions — past and future. The ability to make explicit connections between personal events and self-attributes in life narratives (thought to reflect narrative continuity) was also impaired in patients, but only for past narratives. These results shed new light on the cognitive mechanisms that may underlie the disorders of self in schizophrenia.

The vividness of mental representations of past and future events was lower in patients than controls, in line with previous studies showing that patients had difficulty accessing detailed past memories [26,27,47,53–55], creating detailed representations of future events [29–32,36], re-experiencing past events [25–28] and pre-experiencing future events [29]. It is worth mentioning that, in our study, the lower vividness of patients' mental representations was observed for events considered to be important for the self, which confirms the results of the only two studies to have reported weakened phenomenological continuity in personally significant events, such as events belonging to the reminiscence bump [27] and self-defining future projections [32]. Moreover, since no significant group difference was observed in terms of the temporal distance of events, the lower vividness of events found in patients cannot be due simply to a biased (temporally closer) selection of past or future events. Taken together, our results show, for the first time, that the weakening of phenomenological continuity for personally significant events in schizophrenia is comparable for both directions of time: past and future.

For both patients and controls, projections into future events were less vivid than memories of past events. A previous study by d'Argembeau et al. [56] showed that patients' and controls' representations of future events were less specific than those of past events. These authors also found that this difference was significantly greater in patients with schizophrenia, raising the question of whether the weakening of phenomenological continuity in schizophrenia is more marked for the future than the past. The conceptual distinction recently highlighted by Kyung et al. [57] between memory specificity and vividness may account for this apparent discrepancy between our study and these previous results. d'Argembeau et al. [56] focused on specificity (the ability to remember or imagine unique events lasting less than 24 h), a dimension typically assessed by the experimenter on the basis of verbal descriptions of events. Our own focus in the present study, vividness, reflects the subjective richness of event representations and thus refers to participants' own experience during remembering or imagining. Accordingly, vividness seems more relevant than specificity for assessing phenomenological continuity, but further studies are needed in order to confirm our results and to ascertain whether or not this dimension of self-continuity is impaired to the same extent for the future as for the past in schizophrenia.

The valence of the selected past and future events was overall less positive for patients than controls. This difference may, in part, be due to patients having more

difficult or less successful life trajectories, characterized by a higher frequency of trauma and failures, and a high incidence of social stigma [58–60]. It is worth pointing out that this reduced positivity of selected events cannot be simply explained in terms of depression, as patients currently suffering from depression were not included in our study. Moreover, although patients had less self-esteem than controls, self-esteem levels were not significantly correlated with the valence of events. When examining the effect of temporal direction, we found that both patients and controls considered future events as being more positive than past events. This positivity bias toward the future has been reported extensively in the general population [61–65] and, more recently, in schizophrenia [32]. It may be a way of regulating emotions, enabling individuals to increase, or at least maintain, positive representations of their self in the future [66–68]. The fact that patients with schizophrenia regard future events as being positive may also be part of the recovery process at play for the patients in our sample. All of our patients were clinically stabilized, and several studies have shown that some patients are able to engage in a positive reconstruction of their life after initial episodes of illness [1,69,70]. However, although a positivity bias was observed in patients, the emotional valence of their future thoughts was still lower compared to controls. This finding is in line with recent work reporting an impaired ability to imagine pleasant future events in schizophrenia [31]. This lower positivity (as well as the vividness) of future thoughts could be a consequence of patients' negative symptoms, as suggested by previous studies showing that anticipatory anhedonia and apathy are associated with patients' difficulties in imagining future pleasant events [31,71]. However, no significant correlation was found in our study between patients' negative symptoms or apathy (item N4 of PANSS), and the emotional valence or vividness of future thoughts.

Analyses of the patients' past narratives revealed a reduced capacity to establish explicit connections between personal events and attributes of the self. These findings confirm the reduced autobiographical reasoning capacity in schizophrenia that was initially reported for self-defining memories [35–37,72]. Unlike the results of Raffard et al. [32], in our study, the difference between groups was not significant for future narratives. Self-event connections in future narratives were scant in both groups, however, and a floor effect that might have masked existing group differences cannot be ruled out. It could be the case that establishing explicit connections between imagined future events and dimensions of the self is less frequent when participants are instructed to build extended narratives of their future life (as in the present study) than when they have to focus on specific future events (as in Raffard et al. [32]). It is worth noting that patients produced fewer self-event connections despite clear instructions asking participants to focus on their own self-development and self-evolution in their narratives. Moreover, the fact that the selected events were rated as highly central to their self (with no significant difference between patients and controls in this respect) rules out a possible misunderstanding of the instructions by patients, and argues against the possibility that the lower amount of self-event connections in patients' narratives might be due to their having selected trivial events. Given that self-event connections are critical narrative processes involved in creating self-continuity and self-coherence, not only by emphasizing aspects of personal stability over time, but also by explaining how and why an individual has changed due to life events [18,52,73], our results provide new evidence in support of a weakened narrative self-continuity in schizophrenia, at least as regards the personal past.

The deficits in phenomenological and narrative continuity demonstrated in this study could in part rely on a metacognitive dysfunction [74,75]. According to this view, patients with schizophrenia are characterized by an impaired ability to reflect on mental states, to form complex ideas about themselves and others, and to use that knowledge to respond to life challenges and move toward accomplishing life goals [76–78]. Similarly, patients have difficulty dealing with and integrating different self-facets at one particular moment, and taking into account the evolution of these self-facets across time — a difficulty corresponding to disruptions of the dialogical self [3,74,79]. This metacognitive impairment may in part explain why patients in our study were less able than controls to construct vivid and meaningful mental representations, to establish explicit and coherent relations between aspects of their self and events in their narratives, and to organize coherent life narratives providing self-continuity and self-understanding.

The positive correlation observed in controls between self-event connections in past and future narratives provides evidence for the existence of common mechanisms underlying self-continuity in both temporal directions [24]. The weak, non-significant, correlation observed in patients suggests that these mechanisms may be altered in schizophrenia. Interestingly, however, the proportion of references to the past in patients' future narratives was not lower than that of controls, suggesting that some basic connections between representations of the past and the future may be preserved. Our correlation analyses revealed no significant correlations between dimensions of phenomenological and narrative continuity in either group. This is in keeping with the hypothesis that these two dimensions of self-continuity rely on separate mechanisms [8]. However, very few studies have investigated the relationship between indicators of both dimensions [24]. Additional evidence has been provided by brain imaging studies, which suggest that distinct brain structures are associated with phenomenological and narrative continuity [23]. In particular, autobiographical remembering (which presumably supports phenomenological continuity) engages regions underlying the retrieval of specific events (i.e. posterior cingulate/retrosplenial cortex, precuneus, amygdala/hippocampus, parahippocampal gyrus, dorsolateral prefrontal cortex and medial orbitofrontal

cortex), whereas autobiographical reasoning (which presumably supports narrative continuity) recruits a left-lateralized network involved in conceptual processing (including the dorsomedial prefrontal cortex, inferior frontal gyrus, middle temporal gyrus, and angular gyrus). To the best of our knowledge, only one functional neuroimaging study has investigated autobiographical remembering in patients with schizophrenia [80], and further functional neuroimaging studies should be conducted to disentangle further the neurophysiological correlates of both dimensions of self-continuity in schizophrenia.

Finally, we acknowledge that our study has some limitations. First, the number of self-significant events elicited was rather low. However, asking for a limited number of events may be unavoidable if the aim is to obtain non-trivial events likely to trigger autobiographical reasoning, especially in patients who have difficulty accessing specific events. Second, the order of past and future tasks was not counterbalanced across participants. Although the possibility that this may have influenced our results to some extent cannot be ruled out, previous studies suggest that the carry-over effect from one task to the other (e.g., in terms of event specificity and self-connections) is minimal [24].

5. Conclusion

This study sheds light on disorders of self-continuity in patients with schizophrenia and shows, in particular, that patients have difficulty to construct vivid representations of personally significant events (thought to reflect phenomenological continuity) in both directions of time: past and future. Their ability to establish explicit connections between personal events and attributes of self in life narratives (thought to reflect narrative continuity) is also reduced, but only in past narratives. Some therapeutic interventions have recently been developed to help patients improve their autobiographical memory [47,81–83], and it would be interesting to adapt these interventions to help patients improve the vividness of future event representations. To that end, one promising approach would be to use visual imagery [84], insofar as imagining future events may rely mostly on visual imagery [85], which may improve goal attainment [86]. Moreover, narrative interventions have been developed to help patients create or recreate a coherent life story [87–89]. Some interventions have also suggested that targeting metacognitive abilities in individual therapies may help patients to reconnect with their life story, leading to better functional outcomes [69,90]. These approaches may benefit from integrating future-oriented modules to further improve patients' sense of self-coherence and self-continuity.

Acknowledgment

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