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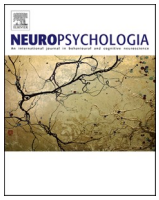

Autobiographical memory in chronic schizophrenia: A follow-up study

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ABSTRACT

Chronic schizophrenia is a very disabling disease and patient's social integration remains difficult. One important aspect is autobiographical memory (AM) as it is impaired in schizophrenia and highly correlated to patient's outcome, since its closely linked to self and identity. Reduced specificity and lack of details are characteristics of patients' AM, but its longitudinal course in schizophrenia remains unclear. We examined 21 patients who underwent our protocol twice with an interval of 7 years. AM was assessed using a semi-structured interview, covering four periods of life and addressing semantic knowledge and autobiographical episodes as well as their details. The results can be divided into three parts, separating semantic memories, specific autobiographical memories and details describing the latter. While a significant deterioration of semantic AM over time could be revealed, the specificity of the free recalled autobiographical episodes remained rather stable – albeit on a low level. In contrast, unique events were remembered with significantly less details at follow-up than at the first examination. While floor-effects given a relatively small number of unique events have to be considered, semantic AM and episodic details seem to be a valuable target for AM remediation given their further deterioration over time.

1. Introduction

Schizophrenia is a very disabling mental disease and the course of chronicity often implicates poor autonomy for patients. It "reduces their ability to lead a normal social and professional life, which restricts or even precludes gainful employment for many patients. This causes personal distress for patients (…)" (p. 41, Gaebel and Wölwer, 2010) and highly diminishes their quality of life (Narvaez et al., 2008). Quality of life in patients suffering from schizophrenia is associated with lower everyday functioning and greater severity of positive, negative and depressive symptoms (Jin et al., 2001; Norman et al., 2000; Ruggeri et al., 2005). However, symptom reduction alone does not necessarily lead to a higher quality of life as problems with everyday functioning, lack of social contacts, unemployment, and stigmatization remain (Narvaez et al., 2008). Moreover, as cognitive abilities are associated with functional capacity and outcome, they may also be related to life satisfaction (Evans et al., 2003; Green et al., 2000, 2004; Palmer et al., 2002; Twamley et al., 2002). Autobiographical memory (AM) refers not only to processes like planning of actions, problem solving, future thinking (directive functions), but also to the development of self-continuity, self-coherence, emotion-regulation (self-related functions) and begin/maintenance of social relationships, empathy and knowledge-transfer (social functions) (Bluck, 2003; Conway and Pleydell-Pearce, 2000; Wilson and Ross, 2003). Therefore, it could be a promising factor for quality of life and social functioning (Corcoran and Frith, 2003; Lysaker et al., 2005; Mehl et al., 2010).

AM as a cognitive ability and part of declarative memory has been described and conceptualized by Conway and Pleydell-Pearce (2000) as a two-factor memory system that serves to adjust one's actions and decisions based on prior knowledge and personal experiences. It includes the entity of knowledge that people have about themselves from past events and experiences to personal goals, feelings, dreams, and beliefs. These memories can be described as pyramidal with general and semantic memory at the top that can give rise to more specific and detailed memories. Therefore, dysfunction of AM can have numerous implications for a person to create an own identity, integrate into society, design and plan one's future and lead a fulfilled life.

In schizophrenia, impoverished AM has been pointed out repeatedly in different studies. These studies almost unanimously confirmed that patients show deficits in retrieving memories of unique personal past events (reduced specificity), in remembering details related to these events and in mentally reliving these events (reduced consciousness). Furthermore, the temporal distribution of personal memories is characterized by an abnormal early reminiscence bump due to the onset of

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the disease in early adulthood (for overview see: Berna et al., 2016; Ricarte et al., 2017; Zhang et al., 2019). This is particularly important as approaches of remediation of AM are starting to develop with the potential to enormously support patients to create and perseverate their self, which could eventually lead to a better quality of life. Different strategies have already been applied in patients with schizophrenia and have been shown to be effective, at least in short-run (Blairy et al., 2008; Dassing et al., 2020; Potheegadoo et al., 2014; Ricarte et al., 2012, 2014). However, most of these studies have been focusing on fairly young patients and the course of AM in older patients with a chronic course of the disease has not been investigated. Several comparative studies on healthy aging with different cohorts and nationalities have shown a reduction of specificity and details with increasing age, i.e. an age-dependent qualitative shift from remembering specific detailed events to a more general representation of AM (semantization). In contrast, semantic knowledge and access to semantic information are better preserved (Addis et al., 2008, 2010; Frankenberg et al., 2021; Holland et al., 2012; Levine et al., 2002; Meléndez et al., 2018; Piolino et al., 2002, 2006).

With this study, we investigated the course of AM in a homogeneous group of older patients with chronic schizophrenia over a mean follow-up interval of 7 years. Therefore, we analyzed AM in an elaborated way, differentiating semantic and episodic AM and episodic details, the temporal distribution, and potential neuropsychological predictors of AM deterioration. A better understanding of AM changes during the course of chronic schizophrenia may be useful for the development of specific strategies for cognitive remediation to improve quality of life in patients. Based on the findings of AM changes in healthy aging we expected corresponding AM changes in schizophrenia.

2. Methods

2.1. Subjects

Twenty-one inpatients with DSM-IV (American Psychiatric Association, 2000) chronic schizophrenia (N = 18) or schizoaffective (N = 3) disorder were recruited at different residential care facilities of St. Thomas e.V. Heidelberg, at follow-up, 7 patients had been placed in nursing homes (for more details of the sample see: Herold et al., 2021). To assess psychopathology, we used the Scale for the Assessment of Positive and Negative Symptoms (SAPS and SANS, Andreasen, 1984a, 1984b), the Brief Psychiatric Rating Scale (BPRS, Overall and Gorham, 1962) and the Apathy Evaluation Scale (AES, Marin et al., 1991). As cognitive screening instrument the Mini Mental State Examination was applied (MMSE, Folstein et al., 1975). Patients received antipsychotic medication according to their psychiatrists' choice and mg chlorpromazine (CPZ) equivalents (Woods, 2003) were calculated (Table 1).

Table 1
Demographic and clinical characteristics.

	T1 n = 21	T2 n = 21	t	p
	Mean (SD)	Mean (SD)		
Education, years	11.7 (2.5)			
Sex, % masculine	71.4%			
Duration of illness, years	23.1 (11.1)	30.7 (10.0)		
Age, years	45.3 (8.7)	52.7 (8.7)		
Age at illness onset, years	22.0 (8.4)	–		
Psychopathology				
BPRS, Sum Score	20.1 (11.2)	15.9 (7.0)	1.456	0.161
SAPS, Sum Score	15.4 (16.1)	12.6 (12.5)	0.826	0.418
SANS, Sum Score	25.1 (15.8)	22.5 (15.5)	0.553	0.587
AES, Sum Score	27.2 (10.5)	26.3 (11.4)	0.508	0.617
CPZ equivalents, mg	459.6 (274.7)	562.9 (292.4)	−1.526	0.143
Cognition, MMSE	26.2 (3.9)	24.1 (4.5)	2.495	0.021

AES Apathy evaluation scale, BPRS Brief psychiatric rating scale, CPZ Chlorpromazine, MMSE Mini.
Mental State Examination, SANS Scale for the assessment of negative symptoms, SAPS Scale for the assessment of positive symptoms.

The AM task was part of a comprehensive neuropsychological test battery, which assessed verbal memory with the subtests logical memory I (immediate recall) and II (delayed recall) from the Wechsler Memory Scale-Revised (WMS-R, Härting et al., 2000), short-term and working memory with the digit span forward and backward from the WMS-R respectively. For the evaluation of psychomotor speed and cognitive flexibility Trail Making Test version A and B (TMT, Reitan, 1992) were applied. The semantic verbal fluency task "Animal Category" from the CERAD (Consortium to Establish a Registry for Alzheimer's Disease) battery (Morris et al., 1989) completed the neuropsychological examination.

All examinations were repeated with a mean interval of 7.38 years (±0.92, range 5–9 years).

The study was approved by the local ethics committee. After full explanation of the study procedure written informed consent was obtained from all participants.

2.2. Autobiographical memory assessment

AM was tested with a semi-structured autobiographical interview (Erweitertes Autobiographisches Gedächtnisinventar, E-AGI: Fast et al., 2007)[1] adapted from Kopelman et al. (1990) and Levine et al. (2002). The E-AGI interview comprises five periods of life (preschool, primary school, secondary school, early adulthood, recent 5 years) for which (1) personal-semantic facts such as proper names of friends, teachers, kindergarten, school or workplace and the personal address are inquired (max. 5 points), (2) two free recalled autobiographical events are solicited and (3) the participants were asked to describe one of these specific autobiographical events from each period of life in detail.

The scores were distributed as follows: For the semantic AM section 5 points in total were possible, in the section of free recalled autobiographical events the specificity of the reported events was rated on a scale from 1 to 3, where 3 points were given for a unique specific event (e.g. "celebration of my 12th birthday"), 2 points for a recurrent event (e.g. "every summer we went to Spain on vacation") and 1 point for a general event (e.g. "when I was young I liked to play soccer"). Thus, for this section a total of 6 points was possible in each period of life. For each unique event (highest specificity level) a maximum of 11 points was given considering the number of details that were remembered: one point for remembering (1) a mental image associated to the event, (2) year/age of occurrence, (3) season, (4) location, (5) environmental details, (6) time of day, (7) duration, (8), weather, (9) involvement of other people, (10) preceding events or consequences, (11) their own or other people's thoughts/emotions/reactions. Recurrent or general events were scored with details = 0, given the fact that in these cases the assignment of details is not possible (for scoring of the E-AGI see also Herold et al., 2013, 2015). As for some of our subjects the 4th and the 5th period of life were overlapping, we excluded the 4th period of life from our analysis.

A previous study of our group revealed a sufficient internal reliability (Cronbach's α) of the scales. The inter-rater reliability ranged from 0.954 to 0.979 (intraclass correlation coefficient, ICC) (Ahlsdorf, 2009).

2.3. Statistical analysis

All statistical analyses were carried out using SPSS statistics version 28.0.1.1., the alpha level was set at $p < 0.05$. Results are given as means and standard deviations (SD). Paired t-tests were used to analyze differences over time with respect to demographic and clinical characteristics and AM scores as well. For the analysis of AM details we additionally used a new method developed by Derrick et al. (2017), as

[1] Detailed manual is available on request.

we had to consider the fact that referring to the quantity of details for both time points of measurement we had two samples that include both, paired and independent observations.

To get a more thorough understanding of the components underlying AM changes in patients with chronic schizophrenia, we performed a hierarchical stepwise linear regression analysis. Age and years of education were introduced in the model as covariates (method: enter). As predictors, we used those neuropsychological variables at T1 (MMSE, logical memory I and II, TMT A and B, verbal fluency) that changed significantly over time (see Herold et al., 2021).

3. Results

3.1. Clinical characteristics

As presented in Table 1, no significant changes ($p > 0.10$) of psychopathology and CPZ equivalents emerged between T1 and T2. Negative symptoms, including apathy, were predominant in our sample according to the respective sum scores. Patients' cognitive performance declined significantly over time, reflected by decreasing general cognitive abilities (MMSE, $p < 0.03$). The longitudinal course of the other cognitive parameters is described in a former publication (Herold et al., 2021).[2]

Patients received different kinds of antipsychotics as well as antidepressants and benzodiazepines. This distribution changed slightly between the two examinations (T1: initial, T2: follow-up): antipsychotic monotherapy with atypical antipsychotics T1 = 17 patients, T2 = 12 patients; combination of atypical and typical antipsychotics T1 = 3 patients, T2 = 8 patients; typical antipsychotics T1 and T2 = 1 patient; antidepressants T1 = 13 patients, T2 = 7 patients; benzodiazepines T1 = 2 patients, T2 = 1 patient.

3.2. Autobiographical memory

In a first step we evaluated the differences between the E-AGI interviews, which were applied approximately seven years apart, for the following three categories: personal semantic facts, autobiographical episodic memory and detailedness of autobiographical memories.

3.2.1. Sematic memory

Patients obtained 17.14 (±2.83) points at T1 and 14.1 (±4.10) points at T2 for the recalled personal semantic facts, thus significantly less at T2 (difference = 3.04; $p < 0.05$), while the maximum is 20 points (5 per period of life). This indicates a significant deterioration of semantic AM in patients with chronic schizophrenia over time with less memories of their former addresses, names of friends, teachers, and/or the institution (e.g. school) they went to (Fig. 1). As presented in Fig. 2, this difference also translates on an individual level.

As a further step, we calculated semantic memory for each period of life separately. Overall, semantic memory decreased for each period of life, however, this difference was only significant for the period "secondary school" (Fig. 3).

To identify neuropsychological predictors of the semantic AM deterioration, we calculated regression analyses. As predictor variables, we used raw scores of the tests MMSE, logical memory I and II, TMT A and B and verbal fluency at T1. These analyses identified verbal fluency beyond age and education to be a significant predictor for semantic memory deterioration, resulting in a model explaining more than 40 % of the variance (Table 2).

3.2.2. Episodic memory

As described in detail in the method section, the episodic memories were evaluated according to a three-point system indicating their specificity level. As we were considering four periods of life and patients were asked to recall two events for each period of life, the maximum score to achieve was 24 points (from 8 episodic memories). Patients obtained a mean of 14.81 (±5.46) points at T1 and 15.33 (±6.48) points at T2 (difference = 0.52; $p = 0.694$) with respect to specificity. Thus, we found no effect of time for episodic AM in terms of specificity of the free recalled autobiographical events (Fig. 1).

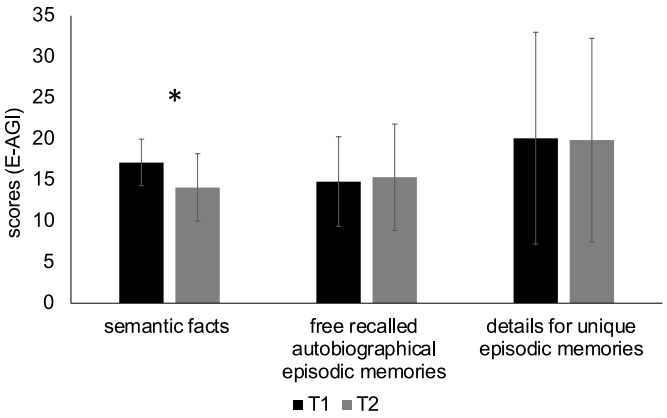

Fig. 1. Mean number of personal semantic facts, specificity of free recalled autobiographical episodic memories and details for unique episodic memories.

3.2.3. Detailedness of episodic memories

In total (over all four periods of life), patients recalled 3.48 (±2.34) unique events (three-point memories) at T1 and 4.14 (±2.37) at T2 ($p = 0.263$) (max. 8 unique events/2 per period of life). Details were retrieved from one unique event per period of life (max. 11 points of detailedness per unique event), therefore patients could reach in total 44 points. Mean scores of details changed not significantly between the two time points of examination (T1 = 20.09 points (±12.90); T2 = 19.86 points (±12.40); $p = 0.945$ (Fig. 1)), if all episodes were considered, which means scoring 0 details for recurrent or general events.

However, the E-AGI scoring system is based on the idea that for each period of life at least one unique event can be remembered and therefore be scored regarding its details. Given a relatively small mean number of unique events, a floor effect in the presented results can be expected, covering a possible effect of time for detailedness. Therefore, in order to compare more directly the mean number of details of all unique events recalled, we replaced the number of participants by the number of actually recalled unique events (T1 = 50; T2 = 58) and used the average details' score per unique event (maximum score = 11). Using this method (see also Herold et al., 2022), we detected a significant effect of time on detailedness (Fig. 4). After seven years, those patients who recalled unique events described them with significantly less details than at the first examination (T1 = 8.24 details (±1.82); T2 = 6.89 details (±2.05); $p < 0.05$).

A more specific analysis considering each period of life individually is presented in Fig. 5: Detailedness decreased for each period of life, though, the difference was only significant for the period "preschool".

Possible neuropsychological predictors of the deterioration of episodic details were calculated with regression analysis, as described in section 3.2.1. TMT A was shown to be a significant predictor of detailedness at T2, resulting in a model explaining more than 20 % of the variance (Table 2).

4. Discussion

Our study aimed at investigating the long-term course of AM in patients with chronic schizophrenia. The following main findings emerged: While semantic memory decreased significantly over time,

[2] For a better overview we added the baseline and follow-up neuropsychological parameters in the supplement.

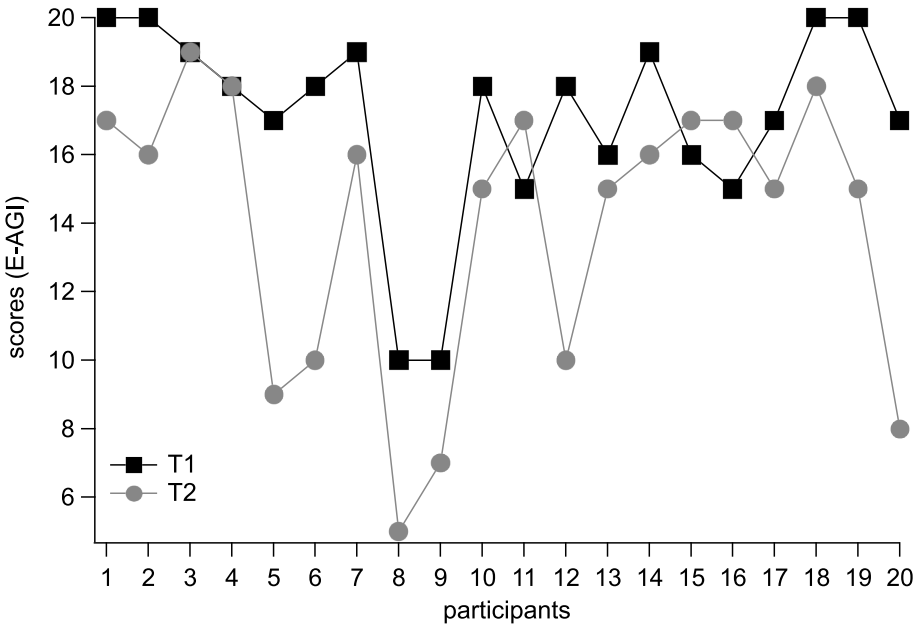

Fig. 2. Individual mean scores for semantic memory at T1 (black) and T2 (grey).

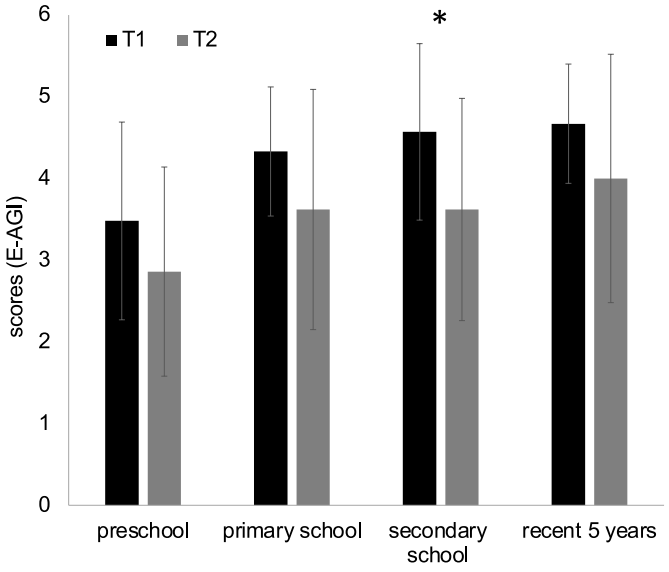

Fig. 3. Semantic memory for each period of life.

autobiographical events, i.e. specificity of AM, remained rather stable. However, detailedness of AM showed a significant deterioration over time if only unique memories were considered. This effect relied on a decline of details from the first period of life (preschool).

Semantic AM decreased significantly over time in our patient group, a finding that is based on the rather intact semantic AM at study entry (mean: 17.14 (±2.83); max score: 20) and on comparable results of semantic AM in healthy controls (Herold et al., 2013, 2015). This is in line with the hypothesis that reduced semantic AM in patients with chronic schizophrenia (see also: Wood et al., 2006) may be restricted to a subgroup of older patients (Herold et al., 2015). As significant predictor of the semantic AM deterioration we identified, beyond age and education, semantic verbal fluency which resulted in a model explaining more than 40 % of the variance. This corresponds well to our result of executive dysfunctions (cognitive flexibility and verbal fluency) at study entry to be significant predictors of neurological soft signs (NSS) increase at follow-up based on the same sample (Herold et al., 2021). NSS, i.e. minor motor and sensory deficits, are demonstrated in the majority of patients with schizophrenia and are significantly associated with neuropsychological impairments (Herold et al., 2019; Schröder and Herold, 2022). Moreover, while semantic memory decreased for each period of life, this difference was only significant for the period "secondary school", which may correspond to the schizophrenia prodrome.

Mean details of unique events also declined significantly over time, which could be attributed to a reduction of detailedness in the first period of life (preschool). In contrast, details from the later periods of life (primary and secondary school, recent 5 years) remained rather intact, which corresponds – at least partly – to a preservation of episodic details from the time of early adulthood. An effect that is known as the reminiscence bump and points to the hypothesis of the development of self and identity during this time (Conway, 2005). Furthermore, the preservation of details from the recent 5 years can be interpreted as a recency effect.

Using regression analysis, we identified in the present study TMT A at baseline to be a significant predictor of detailedness at follow-up. Again, this finding corresponds well to our results of executive dysfunctions, reflected by cognitive flexibility and verbal fluency, to be significant predictors of NSS increase at follow-up based on the same sample (Herold et al., 2021).

A reduction of specificity and details with increasing age has been confirmed in a variety of studies in healthy aging, while in contrast, access to semantic information remains rather preserved. The former can be described as an age-dependent qualitative shift from remembering specific detailed events to a more general representation of AM (semantization) (Addis et al., 2008, 2010; Holland et al., 2012; Levine et al., 2002; Meléndez et al., 2018; Piolino et al., 2002, 2006). However, a general impairment of cognitive abilities already at baseline in our patient group has to be considered, which fits to the hypothesis of accelerated aging in schizophrenia (Kirkpatrick et al., 2008). Cognitive changes and physical diseases at a younger age than in healthy controls correspond to the lower life expectancy of patients with schizophrenia (Laursen, 2011; Olfson et al., 2015) and parallel Kraepelin's concept of dementia praecox (Kraepelin, 1913). In fact, given the reduced MMSE scores (mean: 26.2 ± 3.9) at study entry, which reflect levels obtained in subjects with mild cognitive impairment, deficits in episodic AM could already be expected at time of first examination. Therefore, as described above, in our sample a floor effect regarding the specificity of events can

Table 2
Results of regression analyses.

	Variable	Standardized Beta	T	p	R^2	$F_{[df]}$	R^2 change	Sign. F change
Semantic memory								
Model 1					.222	$F_{[2,18]} = 3.854$*	0.300	3.854*
	Age	−0.390	−1.919	0.071				
	Education	0.488	2.404	0.027				
Model 2					.438	$F_{[3,17]} = 6.200$**	.223	7.925*
	Age	−0.484	−2.755	0.014				
	Education	0.364	2.044	0.057				
	Verbal Fluency	0.502	2.815	0.012				
Detailedness per unique event								
Model 1					.007	$F_{[2,17]} = 1.069$	0.112	1.069
	Age	0.068	0.288	0.777				
	Education	−0.343	−1.462	0.162				
Model 2					.235	$F_{[1,16]} = 2.945$	0.244	6.062*
	Age	−0.035	−0.168	0.868				
	Education	−0.500	−2.316	0.034				
	Trail Making Test A	−0.535	−2.462	0.026				

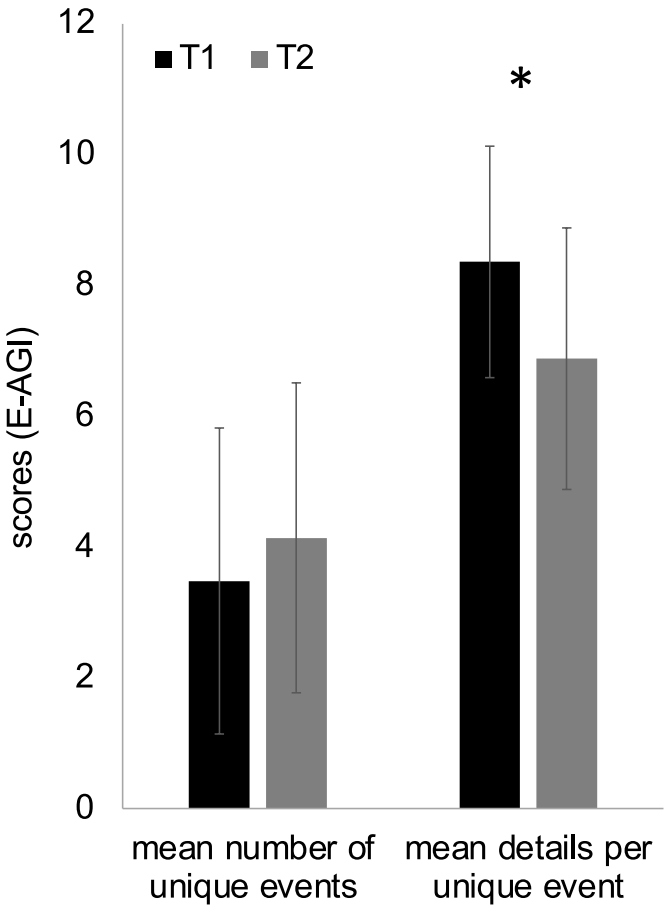

Fig. 4. Unique events only: number and details.

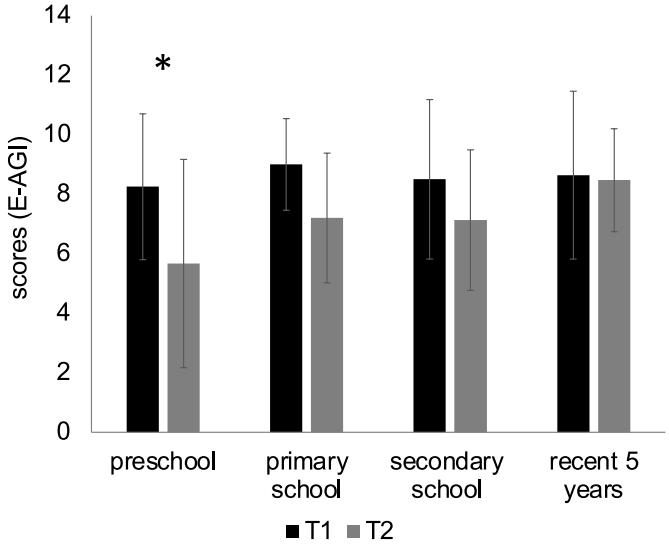

Fig. 5. Detailedness for each period of life.

be assumed, with already low levels at intake and a relatively small number of unique events. At follow-up our patients showed MMSE scores (mean: 24.1 ± 4.5) at levels typically observed in beginning dementia, which was accompanied by a significant further deterioration of episodic details. Moreover, semantic AM was – rather intact at study entry – reflecting a decline over time (Andrejeva et al., 2016; Urbanowitsch et al., 2013). Therefore, our results are not paralleling the dissociation of intact semantic and decreasing episodic AM described in healthy and pathological aging (Frankenberg et al., 2021; Urbanowitsch et al., 2013), but in contrast highlight an already reduced episodic AM at intake that is further deteriorating and a rather intact semantic AM initially that also showed a significant reduction over time.

Beyond this, as already described in our previous publication based on the same sample (Herold et al., 2021) not only general cognition (MMSE), but also verbal memory (logical memory from the WMS-R) and executive functions (verbal fluency task "Animal Category", TMT B) declined significantly over time. Thus, AM is not the only, but probably one of the most complex and therefore most sensitive cognitive functions that decrease over time and an interaction or interdependence with other cognitive domains can be hypothesized. In fact, in the present study we identified verbal fluency and TMT A as significant predictors of semantic and episodic AM deterioration, which explained (together with age and education) up to 40 % of the variance.

Similarly, in a larger sample of 75 patients with chronic schizophrenia we found parameters of AM (number of remembered episodes/specificity sum score) to be significantly correlated especially with domains of working memory and executive functions (Herold et al., 2022). Additionally, an accelerated deterioration of executive functions has been described in patients with schizophrenia in an own cross-sectional study (Herold et al., 2017) as well as in other previous publications (Bowie et al., 2008; Fucetola et al., 2000; Loewenstein et al., 2012). In general, the influence of executive processes on AM retrieval has been highlighted in the past (Conway and Pleydell-Pearce, 2000; Piolino et al., 2009; Sumner, 2012) and can be considered as a transdiagnostic phenomenon, which may explain AM deficits (reduction of specificity

and details) in healthy subjects and healthy aging (Piolino et al., 2010; Ros et al., 2009, 2017), patients with mild cognitive impairment/Alzheimer's disease (El Haj et al., 2015; Greene et al., 1995; Meléndez et al., 2019), with schizophrenia (Berna et al., 2016; Herold et al., 2022; Zhang et al., 2019) or affective disorders (Dalgleish et al., 2007; Williams et al., 2007).

In contrast to decreasing cognitive functions including AM over time in the present sample of chronically ill, psychopathological symptoms remained stable (see Herold et al., 2021 with discussion of psychopathology in detail). The finding of a rather stable psychopathological profile is consistent with the results of a meta-analysis and review (Heilbronner et al., 2016). Based on 35 studies with a follow-up duration of at least six months, authors reported a relatively constant symptomatology: Decreasing or stable positive/negative symptoms (short term) and in the long-term varying positive and relatively constant negative symptoms. A worsening of cognition associated with neurodegeneration in later life is consistent with our recent cross-sectional and longitudinal results (Herold et al., 2017, 2021).

Given an already pronounced impairment of some aspects of AM in patients with chronic schizophrenia (Herold et al., 2013, 2015, 2022) a further worsening over time can be confirmed. This means that cognitive remediation programs are especially important for this patient group as respective interventions may not only improve memories of one's own life, but also the feeling of a coherent sense of identity (Bennouna--Greene et al., 2012; Prebble et al., 2013; Raffard et al., 2010), the ability for future anticipations (D'Argembeau et al., 2008; de Oliveira et al., 2009; Edwards et al., 2020) or social functioning (Alea and Bluck, 2003; Mehl et al., 2010). Based on the present findings, programs for AM remediation may focus on both, semantic AM and episodic details, which further deteriorate over time. Future studies could not only address the question whether remediation of AM alone is sufficient in patients with schizophrenia, but also if training for other closely linked cognitive abilities is needed. Moreover, as AM comprises several cognitive functions, an improvement of other cognitive abilities as a consequence of successful AM training is possible. These assumptions have been recently confirmed meta-analytically based on 22 intervention studies that aimed to improve AM specificity (Ahmadi Forooshani et al., 2020). An effect size of Hedges' $g = 1.08$ for post-test assessments of AM specificity was computed, although the effect was reduced for follow-up assessments. Furthermore, medium to large effect sizes were reported for the improvement of depressive symptoms, life satisfaction and executive functioning, however, only for post-test assessments, not for follow-up. According to these results AM specificity training can be considered at least as an effective short-term intervention for the improvement of AM and mental health.

The generalizability of our results is limited by the relatively small sample size and comorbidity with physical diseases, especially at follow-up (Herold et al., 2021). However, this is a matter of fact and expectable, since we were focusing on patients with a chronic course of schizophrenia (Mitchell et al., 2013a,b; Ringen et al., 2014). However, given the chronicity of the disease in the present patient group the deterioration of AM over time can be seen as independent of the course (i.e. psychopathology) of schizophrenia. This is especially important as the influence of the course of the disorder on psychopathological and neuropsychological characteristics is of clinical relevance (e.g. Bachmann et al., 2005; Herold et al., 2021: course of NSS in first-episode vs. chronic schizophrenia).

The lack of a control group is a further limitation, as a direct comparison of AM over time between patients and healthy subjects is not possible. Nevertheless, the course of AM in healthy controls has already been established in former studies as discussed above. Moreover, given a considerably impaired episodic AM already at study entry (see also: Herold et al., 2013, 2015; Herold et al., 2022) together with a reduction of general cognitive abilities (MMSE) the course of AM in schizophrenia is difficult to compare with that of age-matched healthy controls, who show AM and other cognitive impairments only in older age (see e.g. Frankenberg et al., 2021). This fact also revealed a potential drawback of the standard E-AGI analysis for AM detailedness. In the current study we used a novel scoring method that considers the possibility of a floor effect when AM detailedness remains relatively stable, albeit at a low level, over time. This different scoring technique, which only takes into account unique events for the analysis of details was also used in another publication of our group (Herold et al., 2022), which showed a significantly reduced number of episodes (independent of specificity level) and personal semantic knowledge in a group of $N = 75$ patients with chronic schizophrenia (age: 49.89 ± 11.88 years, duration of illness: 22.99 years ± 13.55) in contrast to healthy controls; moreover, specificity of AM was also significantly lower in this patient group, while richness of details calculated for unique events only showed only minor, non-significant group differences.

To sum up, our results show a significant deterioration of semantic AM and episodic details over a mean follow-up interval of 7 years in patients with chronic schizophrenia. Our findings underline the necessity of cognitive remediation in this patient group targeting episodic and as well as semantic AM.

Ethics statement

The investigations were approved by the ethics committee of the Medical Faculty, H. University.

Written informed consent was obtained from all participants in accordance with the 1964 Declaration of Helsinki and its later amendments after the procedures of the study had been fully explained.

Role of funding source

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Credit author statement

Christina J. Herold: performed data collection, interpretation of data and wrote the manuscript. Céline Z. Duval: supported data collection and performed statistical analyses. Johannes Schröder: supervised clinical assessments and supported critical revision of the manuscript.

Declarations of competing interest

None.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.neuropsychologia.2023.108707.

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