Running head: FUTURE THINKING SCHIZOPHRENIA

Differential associations between impaired autobiographical memory recall and future thinking in people with and without schizophrenia

Tom J. Barry[1,2], David J. Hallford[3], Francisco Del Rey[4] Jorge J. Ricarte[5*]

[1]Department of Psychology, The University of Hong Kong, Hong Kong, Hong Kong.

[2]Department of Psychology, The Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom.

[3] School of Psychology, Deakin University, Victoria, Australia.

[4] Regional Ministry for Social Welfare of Castilla-La Mancha, Albacete, Spain.

[5]Department of Psychology, Faculty of Medicine, University of Castilla-La Mancha, Albacete, Spain.

*Corresponding author: Jorge J. Ricarte (JorgeJavier.Ricarte@uclm.es; +34 967 599 200 Ext. 8293; Facultad de Medicina de Albacete. Universidad de Castilla-La Mancha | C/ Almansa, 14. 02006 Albacete, Spain)

Data availability: The data are available at the following link: https://osf.io/r49eq/

Abstract

Objectives

The ability to think about future events serves a range of important functions. People with schizophrenia show impairments in future thinking. However, whether these impairments are specific to positive or negative events and to what extent they are associated with impairments in verbal fluency and autobiographical memory remains poorly understood.

Methods

People with schizophrenia (n = 93) and people without psychiatric diagnoses (n = 111) were asked to generate future events and retrieve past autobiographical events and completed a test of verbal fluency. Participants also completed questionnaire measures of the positive and negative dimensions of schizophrenia and depression symptoms.

Results

People with schizophrenia generated significantly fewer positive and negative future events than controls. In a linear regression, the interaction between diagnosis and autobiographical memory retrieval explained a significant amount of variance in the number of future events that participants generated even when accounting for symptoms and verbal fluency. Past and future thinking abilities were correlated in controls but not in people with schizophrenia.

Conclusions

People with schizophrenia may not rely on autobiographical content to imagine the future and may rely instead on semantic processes. Interventions that improve past and future thinking amongst people with schizophrenia are warranted.

Keywords

specificity; overgeneral memory; psychosis; depression; verbal fluency

Practitioner points

- Compared to healthy controls without diagnoses, people with schizophrenia have marked difficulty generating possible, positive and negative, future events.
- Unlike controls, for people with schizophrenia there is no relation between their ability to remember past events and their ability to think about the future.
- People with schizophrenia may have difficulty using their memories for their past to imagine and simulate possible future events.

Introduction

The mental simulation of future events is critical for motivation, problem solving, emotion regulation and identity-continuity across time (D'Argembeau, Renaud, & Van Der Linden, 2011). Schizophrenia is consistently related to impairments in future thinking (Hallford, Austin, Takano, & Raes, 2018), yet there are mixed findings regarding the nature of these impairments and their association with other cognitive processes. For example, schizophrenia seems related to reduced anticipatory pleasure, but this may be accounted for by impairments in cognitive processing abilities (Hallford & Sharma, 2019). Further investigation of future thinking abilities in people with schizophrenia are warranted given the important function that pre-experiencing future events plays in providing people with a sense of hope and enabling them to prepare for challenges that they might encounter in their environment (Hallford et al., 2018).

In particular, it remains unclear whether people with psychotic symptoms or schizophrenia, compared to healthy controls without psychiatric diagnoses, have difficulty generating positive *and* negative future events (Goodby & MacLeod, 2016; Raffard, Esposito, Boulenger, & Van der Linden, 2013) or whether the deficit is specific to positive events (Chen et al., 2016). Also, although future thinking impairments may be explained by impairments in autobiographical memory (Kwan, Carson, Addis, & Rosenbaum, 2010; Schacter, Addis, & Buckner, 2007), studies of schizophrenia have shown mixed findings regarding the association between past and future thinking abilities, or have not reported correlations specifically within the clinical group, instead conflating them with diagnoses-free control participants (Chen et al., 2016; D'Argembeau, Raffard, & Van der Linden, 2008). The present investigation provides further evidence regarding the nature of future thinking impairments in schizophrenia, and associations with autobiographical memory abilities.

One reason for the discrepancy between previous studies could be that participants generate fewer events unless explicitly asked to, resulting in insufficient between-participant variability to examine group differences. Goodby and MacLeod (2016) overcame this limitation by asking participants who had experienced positive symptoms of psychosis (e.g., delusion, hallucinations) within the last 12 months to generate as many positive and negative events (events they are looking forward to or are not looking forward to) as possible within three minutes for each valence. These participants showed an impaired ability to generate both positive and negative events compared to controls (Goodby & MacLeod, 2016). These findings warrant replication amongst people with a diagnosis of schizophrenia.

It is worth noting that this future thinking task is similar to a verbal fluency test in which participants verbalise as many members of a category (e.g., animals; *semantic fluency*) or sound (e.g., words beginning with *S*; *phonemic fluency*) within a time limit. Individual differences in verbal fluency are associated with future event generation (Dalgleish et al., 2007) and people with schizophrenia have been found to have significantly impaired verbal fluency compared with healthy participants (Barry, Del Rey, & Ricarte, 2019). Investigations of the association between verbal fluency and future thinking in people with schizophrenia have reported mixed findings in typically small samples ($N \approx 20$), with two studies reporting non-significant findings ($r = -.12$, Raffard et al., 2016; *r not given*, D'Argembeau et al., 2008) and another study reporting a significant positive correlation ($r = .40$, de Oliveira et al., 2009). Clarification of the relation between verbal fluency and future event generation is therefore warranted, particularly with studies that are sufficiently powered (e.g., 80%) to detect correlations in the small-to-moderate range (e.g., $N > 80$).

Another factor besides verbal fluency that might explain between-group differences in future thinking could be differences in autobiographical memory retrieval. Future events are thought to be constructed from information stored in autobiographical memory (Schacter &

Addis, 2007; Schacter et al., 2007) and, correspondingly, difficulty recalling past autobiographical events is typically associated with difficulty imagining future events (Klein, Loftus, & Kihlstrom, 2003; Kwan et al., 2010; Sarkohi, Bjärehed, & Andersson, 2011). In the only study to examine between-group differences in past and future thinking abilities and the relation between these abilities, healthy control participants showed a positive correlation between identity/self-related connections in their past and future narratives, and yet this correlation was not significant for participants with schizophrenia (Allé et al., 2016). Other studies in this area have mostly combined groups of people with and without schizophrenia when reporting correlations between autobiographical memory and future thinking abilities (Chen et al., 2016; D'Argembeau et al., 2008), perhaps due to a limited sample size within each group (N = 16-32). It is possible that in more highly powered studies, group differences may emerge when correlating other aspects of past and future thinking, such as whether the ability to retrieve past events is related to the ability to generate future events.

The present investigation therefore examined the nature of future thinking in people with schizophrenia (n = 93) and controls without psychiatric diagnoses (n = 111), and the association between these abilities and verbal fluency and autobiographical memory retrieval. This investigation utilises the paradigm previously used amongst participants who experienced a single psychotic episode (Goodby & MacLeod, 2016) as this paradigm has yet to be tested amongst participants with diagnoses of schizophrenia and it has several benefits over other similar paradigms as participants are not restricted in the number of positive or negative events that they can generate. It was expected that participants with schizophrenia would show problems generating future events, compared to healthy control participants. In addition, across participants, the ability to retrieve past autobiographical events was expected to correlate positively with the ability to generate possible future events but the strength of this correlation was expected to differ between groups such that for participants with

schizophrenia these abilities would be weakly correlated with one another. Individual differences in verbal fluency were also expected to correlate positively with future thinking abilities.

This analysis additionally examined the contribution of depressive symptoms to future thinking as such symptoms are a common feature of schizophrenia (Gozdzik-Zelazny, Borecki, & Pokorski, 2011; Ricarte, Hernández, Latorre, Danion, & Berna, 2014; Zisook et al., 1999), and have elsewhere been associated with impaired autobiographical memory (Van Vreeswijk & De Wilde, 2004) and future thinking (Hallford et al., 2018). Several within-group correlational analyses were also performed amongst participants with schizophrenia in order to examine whether the characteristics of these participants were associated with their future thinking abilities. In particular, we examine the correlations between future thinking and participants' illness duration and also the severity of their symptoms, measured in terms of the Positive and Negative Syndrome Scale (PANSS). Although several studies have explored this latter relation before, these studies have yielded mixed findings, perhaps due to their limited sample sizes (Chen et al., 2016; D'Argembeau et al., 2008; Raffard et al., 2016), and so further clarification is needed. Participants with more severe depression and schizophrenia symptoms were expected to show worse future thinking abilities.

Method

Participants

Participants with diagnoses of schizophrenia (n = 93) were recruited from the hospital associated with the third author after receiving a diagnosis from their psychiatrist/psychologist in accordance with Diagnostic and Statistical Manual Fifth Edition (DSM-5)(American Psychiatric Association, 2013) criteria. The average age of illness onset was 22.2 years (SD = 4.7) and the average illness duration was 21.67 years (SD = 9.7). 35 participants were in-patients (37.6%) and 58 were outpatients (62.4%). All participants were

receiving antipsychotic medication; 64.5% were also taking anti-anxiety medication, 11.8% were taking anti-depressants and 8.6% were taking medication for extra-pyramidal side effects. To ensure that the participant's responses were not influenced by recent changes to medication, participants with schizophrenia who had changed medication within the past year were excluded. Control participants were recruited through advertisements placed around the nearby community (n = 111). Control participants were interviewed by the third author and were excluded if they were currently experiencing a diagnosable mental health problem within DSM-5. Participants were excluded if they had neurological damage or disability, a history of epilepsy or a history, within the past year, of alcohol or substance abuse. See Table 1 for sample characteristics.

Measures

Episodic future thinking. Participants were asked to describe as many positive (things they would like to happen) and then negative (things they would not like to happen) future events that could occur to them next week, next year and in 5-10 years. Participants were given a minute for each of these periods and valences. Consistent with Macleod and Byrne (Macleod & Byrne, 1996), cuing of these time periods was intended to enhance the ease with which events were generated rather than because we expected there would be differential effects for each time period. As such the total number of events generated for each valence, across time periods, was totalled, excluding repetitions.

Autobiographical memory specificity. The Autobiographical Memory Test (Williams & Broadbent, 1986) was used to measure memory specificity. Participants were shown five positive and five negative cue words (happy, sad, safe, evil, interested, awkward, successful, emotionally hurt, surprised and lonely) and given 60 seconds to recall a specific memory for each. Consistent with psychometric investigations in this area (Griffith, Kleim, Sumner, & Ehlers, 2012; Griffith, Sumner, et al., 2012; Takano, Mori, Nishiguchi, Moriya, & Raes,

2017), verbal responses were transcribed and coded as either specific (unique events that took place within a day more than seven days ago) or non-specific (any other response). The number of specific memories were summed for each cue valence. Memories were coded by the third author, who was blind to participants' group designation at the time of coding.

Verbal fluency. Fluency was assessed by asking participants to generate as many words as possible beginning with *F*, *A* and *S*, within one minute per letter (phonemic fluency), and as many animals as possible within the same time (semantic fluency)(Benton & Hamsher, 1983). The number of words generated was totalled for each form of fluency, excluding repetitions, proper nouns and words of the same origin (e.g., swim and swimming). Higher scores reflected greater fluency.

Symptom measures. The 21-item self-report Beck Depression Inventory Version II (BDI-II) (Beck, Steer, & Brown, 1996; Sanz, Perdigón, & Vázquez, 2003) was used to measure participants' experiences of typical depressive symptoms within the past 2 weeks. Participants rate each item on a 4-point scale such that a higher score reflects more severe experiences and higher total score reflects greater symptoms overall. Scores can range from zero to 63.

The clinician-rated 14-item version of the Positive And Negative Syndrome Scale (PANSS)(Kay, Fiszbein, & Opler, 1987) was used to measure the positive and negative symptom dimensions of schizophrenia. Each item is scored on a 7-point scale such that higher scores reflect worse symptoms. Responses were coded by third author who is trained and experienced in the administration of the PANSS.

Two participants were missing responses on a single item of the BDI-II and three participants were missing a single item on the PANSS. These responses were person-mean imputed before total scores were computed. In the present study, the BDI-II ($\alpha = .91$) and

PANSS positive (α = .73) and negative (α = .82) sub-scale responses showed good internal consistency.

Procedure

The study was approved by the ethical committee of the senior author. Participants attended test sessions either at the university of the senior author or, for people with schizophrenia, at their clinical settings. Information about the study was provided before informed consent was obtained. Participants completed the AMT, the verbal fluency tasks, the BDI-II and then the future thinking task. Participants with schizophrenia also completed the PANSS.

Data analysis

First, we examined each dependent variable for skewness (>-2 to <2 cut-off) and kurtosis (>-7 to <7 cut-off) to ensure that parametric testing was appropriate (West, Finch, & Curran, 1995). Each dependent variable fell within the required cut-offs. Next, we conducted comparisons between participants with schizophrenia and controls on demographic characteristics (age, gender, education) and depression symptoms. Where one of these variables differed significantly between groups, these variables were included within subsequent analyses as covariates. Two univariate ANCOVA then tested for group differences in phonemic and semantic fluency whilst accounting for covariates. Two mixed ANCOVA were then used. The first tested for group differences (2: schizophrenia vs. control) in the number of specific memories retrieved for each cue-type (2: positive vs. negative) in the AMT. The second tested for group differences in the number of future events of different valence (2: positive vs. negative) in the future thinking task. Finally, a hierarchical linear regression examined the factors that contribute towards the number of future events that participants' generated. The first step in this regression included memory specificity and phonemic and semantic fluency along with diagnostic group and covariates identified in earlier analyses. The second step added interaction terms between diagnostic

group and each of the memory specificity and fluency variables to examine whether the relations between these variables and future thinking differed between participants with schizophrenia and controls. Significant interaction effects were followed up with within-group correlations. To examine the relations between the clinical characteristics of participants with schizophrenia and their future thinking abilities, correlations were also performed amongst participants with schizophrenia regarding the relations between the positive and negative sub-scales of the PANSS, the duration of time since participants were diagnosed with schizophrenia and the number of future events generated. In addition, correlations were also performed within each group to explore the associations between depression symptoms and overall, as well as positive and negative, future thinking separately.

Results

See Table 1 for descriptive statistics.

Participant characteristics

There were no differences between groups in the percentage of female participants, $x^2(1) = 0.14$, 95% CI [-0.22, 0.33], $d = 0.05$, or the percentage of participants who obtained university-level education, $x^2(1) = 0.98$, 95% CI [-0.14, 0.41], $d = 0.14$. Compared to controls, participants with schizophrenia were significantly older, $t(202) = -4.65$, $p < .001$, 95% CI[-9.40 -3.80], $d = -0.65$, and had significantly worse depression symptoms, $t(202) = -4.47$, $p < .001$, 95% CI[-8.36, -3.24], $d = -0.63$. There continued to be a significant group difference in depression symptoms even when accounting for differences in participants' ages, $F(1, 201) = 19.90$, $p < .001$, $\eta_g^2 = .08$. Depression symptoms and age were therefore included as covariates in subsequent analyses.

Verbal fluency

There were main effects of group in the ANCOVAs for phonemic, $F(1, 200) = 44.70$, $p < .001$, $\eta_g^2 = .09$, and semantic fluency, $F(1, 200) = 83.80$, $p < .001$, $\eta_g^2 = .19$. These analyses

were repeated without age and depression included as covariates and again there were significant main effects of group for phonemic, $F(1, 202) = 43.09$, $p < .001$, $\eta_g^2 = .17$, and semantic fluency, $F(1, 202) = 81.02$, $p < .001$, $\eta_g^2 = .29$. Compared to controls, participants with schizophrenia had significantly lower scores on the tests of phonemic and semantic fluency.

Autobiographical memory specificity

In the ANCOVA for specific memories recalled, there were significant main effects of group, $F(1, 199) = 6.67$, $p = .010$, $\eta_g^2 = .02$, and valence, $F(1, 199) = 8.14$, $p = .005$, $\eta_g^2 = .01$, but no significant interaction between valence and group, $F(1, 199) = 0.23$, $p = .631$, $\eta_g^2 = .00$. These analyses were repeated with age and BDI removed, to ensure that the presence of any effects of group and valence were not a result of their inclusion in the ANCOVA model. Again, there were significant main effects of group, $F(1, 199) = 12.46$, $p < .001$, $\eta_g^2 = .04$, and valence, $F(1, 199) = 8.52$, $p = .003$, $\eta_g^2 = .01$, but no significant interaction between valence and group, $F(1, 199) = 0.23$, $p = .631$, $\eta_g^2 = .00$. Compared to controls, participants with schizophrenia recalled significantly fewer specific memories. Also, overall, participants recalled more positive than negative memories.

Future thinking

The future thinking mixed ANCOVA showed significant main effects of group $F(1, 199) = 12.94$, $p < .001$, $\eta_g^2 = .05$, and valence, $F(1,199) = 54.26$, $p < .001$, $\eta_g^2 = .04$ but the group by valence interaction was not significant, $F(1,199) = 0.11$, $p = .739$, $\eta_g^2 = .00$. These analyses were repeated with age and BDI scores no longer included as covariates and again, there were significant main effects of group $F(1, 199) = 25.35$, $p < .001$, $\eta_g^2 = .10$, and valence, $F(1,199) = 55.26$, $p < .001$, $\eta_g^2 = .04$, but the group by valence interaction was not significant, $F(1,199) = 0.11$, $p = .739$, $\eta_g^2 = .00$. Compared to controls, participants with schizophrenia generated significantly fewer future events, and although across groups

participants generated fewer negative events than positive events, there was no evidence that the groups differed in their generation of positive, compared to negative, events (see Figure 1).

As there were no significant interactions between group and valence, subsequent correlational and regression analyses were conducted with total scores for specific memories recalled and future events generated.

Linear regression

In the first regression, the number of specific memories participants recalled, B = 0.444, SE = 0.148, p = .003, 95% CI[0.15, 0.74], and individual differences in phonemic fluency, B = 0.249, SE = 0.048, p < .001, 95% CI[0.15, 0.34], both explained significant amounts of variance. Diagnostic group, B = -1.436, SE = 0.801, p = .075, 95% CI[-3.02, 0.14], age, B = -0.033, SE = 0.033, p = .308, 95% CI[-0.10, 0.03], self-reported depression symptoms, B = 0.042, SE = 0.035, p = .230, 95% CI[-0.03, 0.11], and semantic fluency, B = -0.038, SE = 0.1042 p = .712, 95% CI[-0.24, 0.16] did not explain significant amounts of variance. This model explained a significant amount of variance in future event generation, R^2 = .32, $F(6, 197) = 15.18$, p < .001.

In the second step in the regression with interaction terms added, age, B = -0.024, SE = 0.032, p = .445, 95% CI[-0.09, 0.04], self-reported depression symptoms, B = 0.039, SE = 0.034, p = .256, 95% CI[-0.03, 0.11], and semantic fluency, B = -0.024, SE = 0.127, p = .851, 95% CI[-0.27, 0.23], did not explain significant amounts of variance in the number of future events generated. The number of specific memories recalled, B = 0.747, SE = 0.188, p < .001, 95% CI[0.38, 1.12], and individual differences in phonemic fluency, B = 0.278, SE = 0.061, p < .001, 95% CI[0.16, 0.40], also continued to explain significant amounts of variance in future event generation. Diagnostic group now explained a significant amount of variance, B = -2.029, SE = 0.815, p = .014, 95% CI[-3.64, -0.42]. The interaction between memory

specificity and group also predicted a significant amount of variance in future event generation, B = -0.853, SE = 0.298, p = .005, 95% CI[-1.44, -0.26]. However, the interactions between phonemic fluency and group, B = -0.099, SE = 0.096, p = .300, 95% CI[-0.29, 0.09], and semantic fluency and group, B = -0.094, SE = 0.204, p = .645, 95% CI[-0.50, 0.31], did not explain significant amounts of variance. This second step explained a significant amount of variance in future event generation, R^2 = .35, $F(9, 194) = 11.74$, $p < .001$, and explained significantly more variance than the first step, ΔR^2 = .04, $F(3, 194) = 3.63$, p = .013.

Correlational analysis

Follow-up, within-group, correlations examined the interaction between specificity and group in predicting overall (across valence) abilities to generate future events. Amongst control participants, recall of more specific memories was correlated positively with the generation of more future events, r = .38, $p < .001$. However, amongst participants with schizophrenia, their ability to recall specific events was not significantly related to their ability to generate future events, r = -.07, p = .512 (see Figure 2). These correlation coefficients were significantly different from one another, Z = 3.294, p = .001, 95% CI[0.18, 0.69].

Correlations between the symptom sub-scales of the PANSS and total future thinking scores, as well as valence-specific (positive future thoughts and negative future thoughts) scores yielded null findings (largest r = .06, smallest p = .543). Also, there was no correlation between the duration of time since participants were diagnosed with schizophrenia and their overall future thinking abilities, r = -.06, p = .566, or their ability to generate positive, r = -.05, p = .631, or negative events, r = -.06, p = .591.

Although BDI-II scores were not associated with total future thinking scores in the regression analyses, it remained possible that BDI-II scores might correlate with positive and negative future thinking scores separately. Indeed, amongst control participants there was no

correlation between BDI-II scores and positive future thinking scores, r = -0.03, p = .739, and yet BDI-II scores correlated significantly with negative future thinking scores, r = .20, p = .036. Amongst participants with schizophrenia BDI-II scores did not correlate significantly with positive, r = -.09, p = .365, or negative, r = .03, p = .810, future thinking scores.

Discussion

The present investigation replicated and extended on studies comparing the ability to generate future events between people with and without schizophrenia (Chen et al., 2016; D'Argembeau et al., 2008; de Oliveira et al., 2009; Huddy, Drake, & Wykes, 2016; Raffard et al., 2016, 2013). People with schizophrenia were found to have a broad deficit in their ability to generate future events compared to healthy control who did not have psychiatric diagnoses, with problems generating both positive and negative future events, compared to controls. This findings is in line with some previous evidence (Goodby & MacLeod, 2016; Raffard et al., 2013) but contrasts with another investigation which found evidence of a between-group difference for positive but not negative events (Chen et al., 2016). Participants in the latter investigation recalled so few negative events that this may have restricted the researchers' ability to examine between-group differences. By asking participants with schizophrenia to recall as many events as possible within a fixed time period, we extended the findings of others (Goodby & MacLeod, 2016) who studied these effects amongst a heterogeneous sample of individuals defined by positive psychotic symptoms within the last 12 months. It is of note that, unlike previous studies that employed the same future thinking task (Goodby & MacLeod, 2016), our study did not counterbalance the order of positive and negative cues within this task. Although participants were given as much time as they needed to rest between tasks and cues if they felt fatigued, it remains possible that the main effect of valence observed in our overall ANOVA for the future thinking task was attributable to fatigue. However, the main effect of Group, and the absence of a significant interaction

between Group and Valence, nevertheless indicated that participants with schizophrenia diagnoses showed a broad deficit in the generation of future events compared to healthy controls. As such, subsequent regression analyses were collapsed across valence categories. Future implementations of this task should counterbalance the order of positive and negative cues.

Across all participants, there was evidence that reduced recall of specific autobiographical memories was associated with impairment in the generation of future events, consistent with other studies (Chen et al., 2016; D'Argembeau et al., 2008). However, the relations between these abilities may differ between participants with schizophrenia and controls, such that past and future thinking abilities correlated positively amongst controls but did not correlate amongst people with schizophrenia.

That this correlation was not significant for people with schizophrenia aligns with those of another study (Allé et al., 2016) and suggestions that people with schizophrenia can experience a lack of continuity in the past and future selves (de Oliveira et al., 2009; Neumann, Blairy, Lecompte, & Philippot, 2007; Potheegadoo, Berna, Cuervo-Lombard, & Danion, 2013). It may be that as people with schizophrenia are less able to retrieve events from their past than healthy controls, they are also less likely to then integrate these experiences into their imaginings of the future. As such, they may have difficulty imagining any future at all, as evidenced here, and also in experiencing this future as self-relevant. Also, if the specificity with which people with schizophrenia think about past experiences is unrelated to their future thinking abilities then we would expect that inducing patients to think in a specific way about past experiences, such as with Memory Specificity Training (MeST; Barry, Sze, & Raes, 2019; Raes, Williams, & Hermans, 2009), would have no effect on their future thinking. Future research could explore this possibility.

These findings emphasise the importance of interventions that seek to help people with schizophrenia with their impairments in past and future thinking (Blairy et al., 2008). Problems in both of these domains are a common characteristic of schizophrenia and yet existing interventions do not directly address them. As such, in depression for example, problems with memory specificity have been found to predict the subsequent re-emergence of symptoms amongst people who are in remission (Kleim & Ehlers, 2008). In addition, cognitive-behavioural interventions encourage people to consider and change their dysfunctional thinking about their past and future (Hitchcock et al., 2019). As such, past and future thinking abilities are likely to play an important role in both treatment progress and, if left unchanged following treatment, might also predict relapse. Existing cognitive-behavioural interventions for schizophrenia should therefore give additional assistance to people who have particular difficulty thinking about their past and future so that problems with these abilities do not interfere with the normal progress of treatment. Clinicians could also utilise techniques from interventions that target past and future thinking abilities (Blairy et al., 2008) or which help to enhance aspects of meta-cognition that are involved in binding together past and future experiences into a cohesive self-relevant narrative (Schweitzer, Greben, & Bargenquast, 2017).

Findings from studies with other groups of participants might also offer insights into our findings amongst people with schizophrenia. For example, the problems older adults experience relative to younger adults in imagining future events appears to be more related to non-episodic factors such as impoverished executive functioning or narrative style and communicative goals than to episodic factors related to memory recall as is the case for younger adults (Schacter, Gaesser, & Addis, 2013). In the present study, problems with phonemic fluency contributed towards performance in the future thinking task but these problems did not account fully for their future thinking impairments. Future research could

explore the contribution of other non-episodic, narrative or communicative factors, to future thinking problems amongst people with schizophrenia.

This investigation did not replicate the effects of others regarding the association between positive psychotic symptoms and future event generation and pre-experiencing (D'Argembeau et al., 2008; Raffard, D'Argembeau, Bayard, Boulenger, & Van der Linden, 2010). However, other studies in this area also failed to replicate these effects (Chen et al., 2016; Raffard et al., 2016). We also did not find a significant correlation between the duration of time that participants had had diagnoses of schizophrenia and future thinking. The absence of an association between overall future event generation and depressive symptoms in our regression analyses contrasts with studies with non-clinical (Marsh, Edginton, Conway, & Loveday, 2019) and depressed and anxious (Macleod & Byrne, 1996; Sarkohi et al., 2011) participants, but is in agreement with the findings of another study with participants who had experienced a single psychotic episode (Goodby & MacLeod, 2016). Our within-group correlation analysis amongst schizophrenia participants also supported the findings of Goodby & MacLeod (2016) as there were no significant correlations between positive or negative future thinking and depressions symptoms. The same within-group analyses amongst controls suggested that enhanced generation of negative future events, but not positive events, was associated with heightened depression symptoms. Amongst people with schizophrenia and psychotic experiences, problems with future thinking may be a broad feature of their disorder, independent of symptom severity or the duration of their illness.

It is of note that our investigation assumes that if past and future thinking abilities correlate that this is an indication that simulations of future events are constructed from episodic memories. Although there is ample experimental and neuroscientific evidence to suggest past and future thinking are related (Kwan et al., 2010; Sarkohi et al., 2011; Schacter et al., 2007; Zheng, Luo, & Yu, 2014), we did not directly examine the causal relation

between past and future thinking or whether the future events that participants generated were actually constructed by information stored in memory. As previously mentioned, future research might manipulate recall abilities, such as with MeST in order to examine the effects of this on future thinking. Alternatively, studies might utilise experimental manipulations of recall prior to a future thinking task (Jing, Madore, & Schacter, 2017; Painter & Kring, 2016) or they might examine the similarity between past and future thoughts in terms of their sensory-perceptual details (Zheng et al., 2014).

It remains possible that the effects observed here are a function of anti-psychotic medication. Future research could investigate this possibility by comparing people who are and who are not medication naïve. Nevertheless, our findings indicate that anti-psychotic medications do not alleviate any problems with future thinking, autobiographical recall or verbal fluency that people with schizophrenia typically experience. Also, it is of note that many participants in the present investigation's schizophrenia group were taking medication for anxiety. This indicates that clinical anxiety may have been high in this group at the time of the investigation. However, as these symptoms were not directly measured, this cannot be directly ascertained. Hallford et al. (2019) have shown that increased state anxiety can impact on memory specificity and may be a factor in the group differences observed here. Although they did not find that increased state anxiety impacted on future thinking specificity, it may nonetheless be possible that anxious symptoms contributed towards these group differences. As such, future investigations should quantify individual differences in state and trait anxious symptoms. Relatedly, although our investigation replicates the findings of others regarding future thinking impairments in schizophrenia, it remains possible that these findings are not specific to schizophrenia and are instead a function of the experience of mental illness or are transdiagnostic in nature (Hallford et al., 2018). Future research in this area should compare participants with diagnoses of schizophrenia to participants with other diagnoses associated

with future thinking impairments to examine the specificity of these impairments. It is also possible that, although age and depression were included as covariates in our ANOVA and regression, these variables may have nonetheless influenced the findings of our study. In an effort to achieve our desired sample size we did not match participants on these variables but future studies should endeavour to sample matched patients and controls.

In overview, we provide an investigation of impairments in future thinking amongst people with schizophrenia and factors contributing to these problems. People with schizophrenia have difficulty thinking about positive and negative events. Also, unlike healthy controls, for people with schizophrenia past and future thinking abilities are unrelated to one another. These findings have important implications for how people with schizophrenia think about their past and future. They also emphasise the importance of developing novel interventions that seek to enhance both past and future thinking abilities amongst people with schizophrenia (e.g., Blairy et al., 2008).

References

Allé, M. C., D'Argembeau, A., Schneider, P., Potheegadoo, J., Coutelle, R., Danion, J. M., & Berna, F. (2016). Self-continuity across time in schizophrenia: An exploration of phenomenological and narrative continuity in the past and future. *Comprehensive Psychiatry*, *69*, 53–61. https://doi.org/10.1016/j.comppsych.2016.05.001

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Arlington, VA, VA: American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596.744053

Barry, T. J., Del Rey, F., & Ricarte, J. J. (2019). Valence-related impairments in the retrieval of specific autobiographical memories amongst patients with schizophrenia. *British Journal of Clinical Psychology*, *58*(2), 140–153. https://doi.org/10.1111/bjc.12205

Barry, T. J., Sze, W. Y., & Raes, F. (2019). A meta-analysis and systematic review of Memory Specificity Training (MeST) in the treatment of emotional disorders. *Behaviour Research and Therapy*, *116*(November 2018), 36–51. https://doi.org/10.1016/j.brat.2019.02.001

Beck, A., Steer, R., & Brown, G. (1996). *Beck Depression Inventory-II*. San Antonio, TX: Psychological Corperation. https://doi.org/10.1037/t00742-000

Benton, A., & Hamsher, K. (1983). *Multilingual Aphasia Examination. Manual of Instructions*. *AJA Associates, Inc.* Iwoa City, Iwoa.

Blairy, S., Neumann, A., Nutthals, F., Pierret, L., Collet, D., & Philippot, P. (2008). Improvements in autobiographical memory in schizophrenia patients after a cognitive intervention: A preliminary study. *Psychopathology*, *41*(6), 388–396. https://doi.org/10.1159/000155217

Chen, X. jie, Liu, L. lu, Cui, J. fang, Wang, Y., Chen, A. tao, Li, F. hua, … Chan, R. C. K. (2016). Schizophrenia spectrum disorders show reduced specificity and less positive

events in mental time travel. *Frontiers in Psychology*, *7*(JUL), 1–8. https://doi.org/10.3389/fpsyg.2016.01121

D'Argembeau, A., Raffard, S., & Van der Linden, M. (2008). Remembering the Past and Imagining the Future in Schizophrenia. *Journal of Abnormal Psychology*, *117*(1), 247–251. https://doi.org/10.1037/0021-843X.117.1.247

D'Argembeau, A., Renaud, O., & Van Der Linden, M. (2011). Frequency, characteristics and functions of future-oriented thoughts in daily life. *Applied Cognitive Psychology*, *25*(1), 96–103. https://doi.org/10.1002/acp.1647

Dalgleish, T., Williams, J. M. G., Golden, A. J., Perkins, N., Barrett, L. F., Barnard, P. J., … Watkins, E. (2007). Reduced Specificity of Autobiographical Memory and Depression : The Role of Executive Control. *Journal of Experimental Psychology. General*, *136*(1), 23–42. https://doi.org/10.1037/0096-3445.136.1.23

de Oliveira, H., Cuervo-Lombard, C., Salamé, P., & Danion, J.-M. (2009). Autonoetic awareness associated with the projection of the self into the future: An investigation in schizophrenia. *Psychiatry Research*, *169*(1), 86–87. https://doi.org/10.1016/j.psychres.2008.07.003

Goodby, E., & MacLeod, A. K. (2016). Future-directed thinking in first-episode psychosis. *British Journal of Clinical Psychology*, *55*(2), 93–106. https://doi.org/10.1111/bjc.12096

Gozdzik-Zelazny, A., Borecki, L., & Pokorski, M. (2011). Depressive symptoms in schizophrenic patients. *European Journal of Medical Research*, *16*(12), 549–552. https://doi.org/10.1186/2047-783X-16-12-549

Griffith, J. W., Kleim, B., Sumner, J. A., & Ehlers, A. (2012). The factor structure of the Autobiographical Memory Test in recent trauma survivors. *Psychological Assessment*, *24*(3), 640–646. https://doi.org/10.1037/a0026510

Griffith, J. W., Sumner, J. A., Raes, F., Barnhofer, T., Debeer, E., & Hermans, D. (2012).

Current psychometric and methodological issues in the measurement of overgeneral autobiographical memory. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*, 21–31. https://doi.org/10.1016/j.jbtep.2011.05.008

Hallford, D. J., Austin, D. W., Takano, K., & Raes, F. (2018). Psychopathology and episodic future thinking: A systematic review and meta-analysis of specificity and episodic detail. *Behaviour Research and Therapy*, *102*(September 2017), 42–51. https://doi.org/10.1016/j.brat.2018.01.003

Hallford, D. J., Mellor, D., Bafit, L., Devenish, B., Bogeski, T., Austin, D. W., & Kaplan, R. (2019). The effect of increasing state anxiety on autobiographical memory specificity and future thinking. *Journal of Behavior Therapy and Experimental Psychiatry*, *65*, 101488. https://doi.org/10.1016/j.jbtep.2019.101488

Hallford, D. J., & Sharma, M. K. (2019). Anticipatory pleasure for future experiences in schizophrenia spectrum disorders and major depression: A systematic review and meta-analysis. *British Journal of Clinical Psychology*. https://doi.org/10.1111/bjc.12218

Hitchcock, C., Rudokaite, J., Patel, S., Smith, A., Kuhn, I., Watkins, E., & Dalgleish, T. (2019). Role of autobiographical memory in patient response to cognitive behavioural therapies for depression: Protocol of an individual patient data meta-analysis. *BMJ Open*, *9*(6), 1–7. https://doi.org/10.1136/bmjopen-2019-031110

Huddy, V., Drake, G., & Wykes, T. (2016). Mental simulation and experience as determinants of performance expectancies in people with schizophrenia spectrum disorder. *Psychiatry Research*, *237*, 97–102. https://doi.org/10.1016/j.psychres.2016.01.072

Jing, H. G., Madore, K. P., & Schacter, D. L. (2017). Preparing for what might happen: An episodic specificity induction impacts the generation of alternative future events. *Cognition*, *169*(September), 118–128. https://doi.org/10.1016/j.cognition.2017.08.010

Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophrenia Bulletin*, *13*(2), 261–276. https://doi.org/10.1093/schbul/13.2.261

Kleim, B., & Ehlers, A. (2008). Reduced autobiographical memory specificity predicts depression and posttraumatic stress disorder after recent trauma. *Journal of Consulting & Clinical Psychology*, *76*(2), 231–242. https://doi.org/10.1037/0022-006X.76.2.231

Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2003). Memory and Temporal Experience: the Effects of Episodic Memory Loss on an Amnesic Patient's Ability to Remember the Past and Imagine the Future. *Social Cognition*, *20*(5), 353–379. https://doi.org/10.1521/soco.20.5.353.21125

Kwan, D., Carson, N., Addis, D. R., & Rosenbaum, R. S. (2010). Deficits in past remembering extend to future imagining in a case of developmental amnesia. *Neuropsychologia*. https://doi.org/10.1016/j.neuropsychologia.2010.06.011

Macleod, A. K., & Byrne, A. (1996). Anxiety, Depression, and the Anticipation of Future Positive and Negative Experiences. *Journal of Abnormal Psychology*, *105*(2), 286–289. https://doi.org/10.1037/0021-843X.105.2.286

Marsh, L., Edginton, T., Conway, M. A., & Loveday, C. (2019). Positivity bias in past and future episodic thinking: Relationship with anxiety, depression, and retrieval-induced forgetting. *Quarterly Journal of Experimental Psychology*, *72*(3), 508–522. https://doi.org/10.1177/1747021818758620

Neumann, A., Blairy, S., Lecompte, D., & Philippot, P. (2007). Specificity deficit in the recollection of emotional memories in schizophrenia. *Consciousness and Cognition*, *16*(2), 469–484. https://doi.org/10.1016/j.concog.2006.06.014

Painter, J. M., & Kring, A. M. (2016). Toward an understanding of anticipatory pleasure deficits in schizophrenia: Memory, prospection, and emotion experience. *Journal of*

Abnormal Psychology, *125*(3), 1–11. https://doi.org/http://dx.doi.org/10.1037/abn0000151

Potheegadoo, J., Berna, F., Cuervo-Lombard, C., & Danion, J. M. (2013). Field visual perspective during autobiographical memory recall is less frequent among patients with schizophrenia. *Schizophrenia Research*, *150*(1), 88–92. https://doi.org/10.1016/j.schres.2013.07.035

Raes, F., Williams, J. M. G., & Hermans, D. (2009). Reducing cognitive vulnerability to depression: A preliminary investigation of MEmory Specificity Training (MEST) in inpatients with depressive symptomatology. *Journal of Behavior Therapy and Experimental Psychiatry*, *40*(1), 24–38. https://doi.org/10.1016/j.jbtep.2008.03.001

Raffard, S., Bortolon, C., D'Argembeau, A., Gardes, J., Gely-Nargeot, M. C., Capdevielle, D., & Van der Linden, M. (2016). Projecting the self into the future in individuals with schizophrenia: a preliminary cross-sectional study. *Memory*, *24*(6), 826–837. https://doi.org/10.1080/09658211.2015.1057152

Raffard, S., D'Argembeau, A., Bayard, S., Boulenger, J. P., & Van der Linden, M. (2010). Scene Construction in Schizophrenia. *Neuropsychology*, *24*(5), 608–615. https://doi.org/10.1037/a0019113

Raffard, S., Esposito, F., Boulenger, J. P., & Van der Linden, M. (2013). Impaired ability to imagine future pleasant events is associated with apathy in schizophrenia. *Psychiatry Research*, *209*(3), 393–400. https://doi.org/10.1016/j.psychres.2013.04.016

Ricarte, J. J., Hernández, J. V., Latorre, J. M., Danion, J. M., & Berna, F. (2014). Rumination and autobiographical memory impairment in patients with schizophrenia. *Schizophrenia Research*, *160*(1–3), 163–168. https://doi.org/10.1016/j.schres.2014.10.027

Sanz, J., Perdigón, A. L., & Vázquez, C. (2003). Adaptación española del Inventario para la Depresión de Beck-II (BDI-II): 2.Propiedades psicométricas en población general.

Clinica y Salud, *14*(3), 249–280.

Sarkohi, A., Bjärehed, J., & Andersson, G. (2011). Links Between Future Thinking and Autobiographical Memory Specificity in Major Depression. *Psychology*, *02*(03), 261–265. https://doi.org/10.4236/psych.2011.23041

Schacter, D. L., & Addis, D. R. (2007). Constructive memory: The ghosts of past and future. *Nature*, *445*(7123), 27. https://doi.org/10.1038/445027a

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: The prospective brain. *Nature Reviews Neuroscience*, *8*(9), 657–661. https://doi.org/10.1038/nrn2213

Schacter, D. L., Gaesser, B., & Addis, D. R. (2013). Remembering the past and imagining the future in the elderly. *Gerontology*, *59*(2), 143–151. https://doi.org/10.1159/000342198

Schweitzer, R. D., Greben, M., & Bargenquast, R. (2017). Long-term outcomes of Metacognitive Narrative Psychotherapy for people diagnosed with schizophrenia. *Psychology and Psychotherapy: Theory, Research and Practice*, *90*(4), 668–685. https://doi.org/10.1111/papt.12132

Takano, K., Mori, M., Nishiguchi, Y., Moriya, J., & Raes, F. (2017). Psychometric properties of the written version of the autobiographical memory test in a japanese community sample. *Psychiatry Research*, *248*(December 2016), 56–63. https://doi.org/10.1016/j.psychres.2016.12.019

Van Vreeswijk, M. F., & De Wilde, E. J. (2004). Autobiographical memory specificity, psychopathology, depressed mood and the use of the Autobiographical Memory Test: A meta-analysis. *Behaviour Research and Therapy*, *42*(6), 731–743. https://doi.org/10.1016/S0005-7967(03)00194-3

West, S., Finch, J., & Curran, P. (1995). Structural equation models with nonnormal variables: Problems and remedies. In *Structural equation modeling: Concepts, issues,*

and applications; structural equation modeling: Concepts, issues, and applications.

Williams, J. M. G., & Broadbent, K. (1986). Autobiographical memory in suicide attempters. *Journal of Abnormal Psychology*, *95*, 144–149. https://doi.org/10.1037/0021-843X.95.2.144

Zheng, H., Luo, J., & Yu, R. (2014). From memory to prospection: What are the overlapping and the distinct components between remembering and imagining? *Frontiers in Psychology*, *5*(AUG), 1–14. https://doi.org/10.3389/fpsyg.2014.00856

Zisook, S., McAdams, L. a, Kuck, J., Harris, M. J., Bailey, A., Patterson, T. L., … Jeste, D. V. (1999). Depressive symptoms in schizophrenia. *The American Journal of Psychiatry*, *156*(11), 1736–1743. https://doi.org/10.1176/ajp.156.11.1736

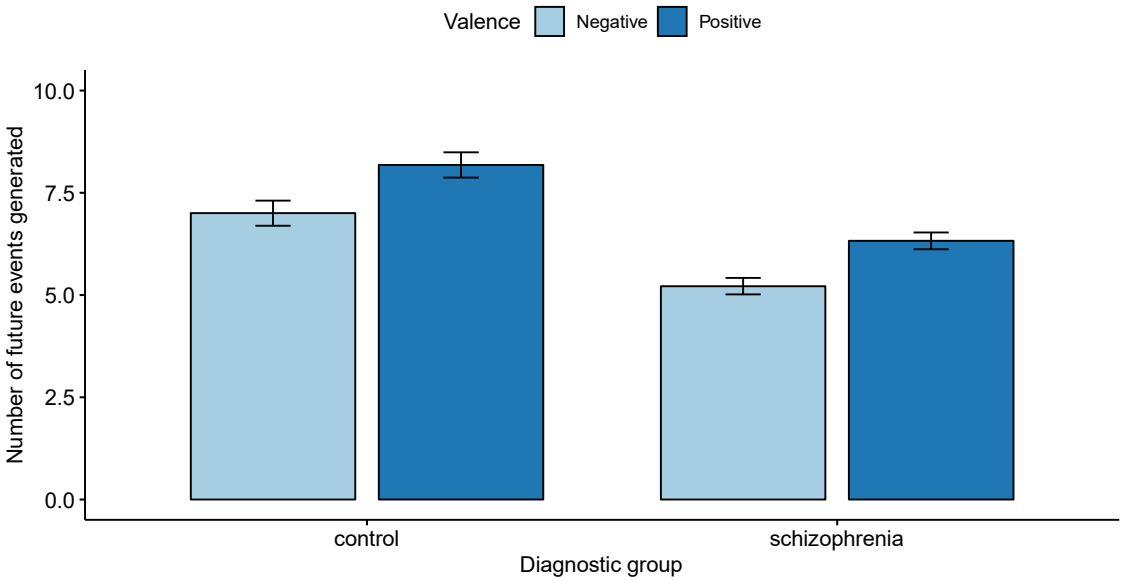
Table 1. Sample characteristics

	Group	
	Control	Schizophrenia
n	111	93
Females (%)	38.7	45.2
Education (%)	9.0	5.4
Age (*M*(*SD*))	37.25(10.25)	43.85(9.93)
BDI-II (*M*(*SD*))	9.13(8.45)	14.93(10.08)
PANSS (*M*(*SD*))		
Positive		15.81(3.22)
Negative		17.39(4.03)
Fluency (*M*(*SD*))		
Phonemic	30.73(9.04)	22.96(7.62)
Semantic	14.79(4.21)	9.80(3.60)
Future events (*M*(*SD*))	15.18(6.04)	11.54(3.47)
Positive	8.18(3.25)	6.32(1.96)
Negative	7.00(3.25)	5.22(1.95)
Specificity (*M*(*SD*))	4.80(2.30)	3.71(2.02)
Positive	2.58(1.27)	1.96(1.30)
Negative	2.23(1.47)	1.72(1.25)

Note. Group size (*n*), proportion of females (Females) and means and standard deviations for each dependent variable for control participants and participants with schizophrenia. Education refers to the percentage of participants who obtained university-level education. BDI: Beck Depression Inventory Version II; PANSS: Positive and Negative Syndrome

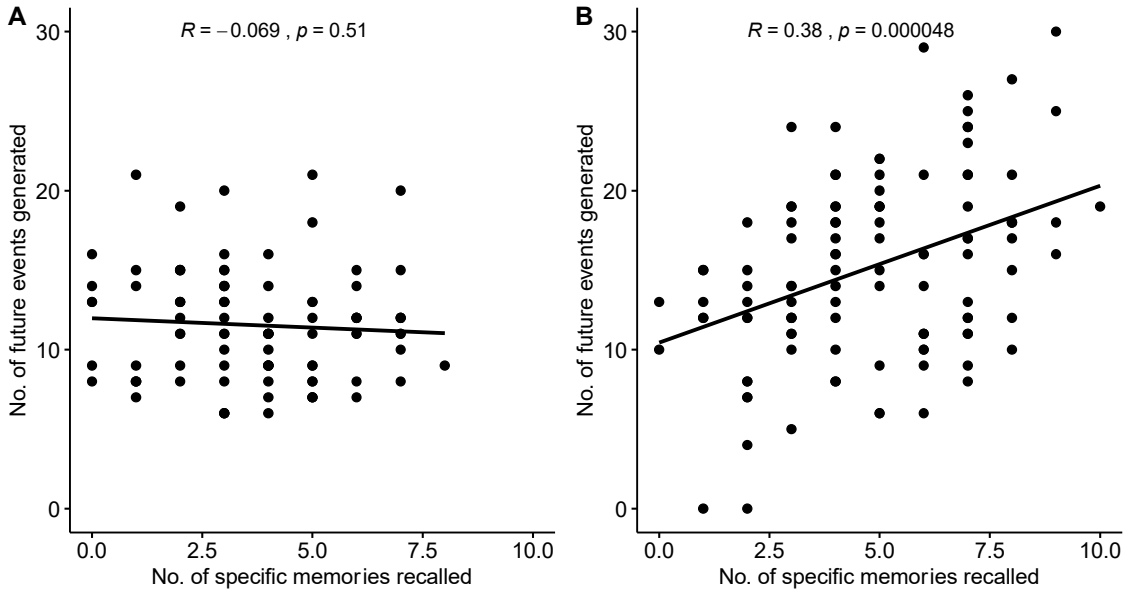
Scales; Future events: Number of future events generated; Specificity: Number of specific autobiographical memories reported.

Figure 1. Bar plots



Note. Mean number of negative and positive future events generated (with standard error bars) by people with schizophrenia and diagnosis-free controls.

Figure 2. Scatter plots



Note. Scatter plots of the number of specific memories recalled in the Autobiographical Memory Test (AMT) and the number of future events generated for patients with schizophrenia (A) and control participants (B). The regression line and confidence intervals, as well as correlation coefficients (r) and *p* values, are given for each group.