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Time will tell: Associations between unbalanced time perspectives and symptom severity in individuals with schizophrenia spectrum disorders

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ABSTRACT

Patients with schizophrenia spectrum disorder (SSD) experience disrupted temporality on the immediate time-scale. However, insufficient information is available for longer time frames, and the interaction of temporal perspectives with the clinical manifestations of SSD is unknown. We explored the association between unbalanced time perspectives and symptom severity. Thirty-seven Italian mental health services participating in the DiAPAson project recruited 620 patients with DSM-5 SSD (68 % males, mean age = 41.3 ± 9.5 years). Time perspective biases were measured using the Deviation from the Balanced Time Perspective-revisited (DBTP-r) indicator, based on Zimbardo Time Perspective Inventory (ZTPI) scores. Psychiatric symptoms were assessed using the Brief Psychiatric Rating Scale (BPRS) and Brief Negative Symptoms Scale (BNSS). Preliminary analyses examined the associations between ZTPI/DBTP-r and BPRS/BNSS total scores. In secondary analyses, we first tested the associations between the ZTPI/DBTP-r and BPRS/BNSS subscales and then compared ZTPI differences between patients with and without hallucinations, delusions, and conceptual disorganisation. Statistical significance was set at Holm-Bonferroni corrected $p < 0.05$. Low-to-moderate positive correlations were found between the DBTP-r and BPRS/BNSS total scores ($r = 0.29/0.22$). The strongest associations were between DBTP-r/ZTPI_Past-Negative and anxiety/depression ($r = 0.34/0.36$), followed by DBTP-r/ZTPI_Present-Fatalistic with thought disturbances ($r = 0.22/0.20$). DBTP-r was associated with BNSS anhedonia and avolition ($r = 0.21/0.24$). DBTP-r was higher in patients with hallucinations (ES = 0.391) and conceptual disorganisation (ES = 0.397) than in those without these symptoms. Unbalanced time perspective was positively associated with the severity of primary and secondary SSD features. These findings provide a rationale for empirical tests focused on balancing time perspectives in patients with SSD.

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1. Introduction

Temporality is a critical aspect of schizophrenia, where time experience is atypical and the past, present, and future are often confused (Fusar-Poli et al., 2022). A standard clinical conceptualisation of schizophrenia suggests differentiating between negative, positive, and disorganized symptoms (Andreasen et al., 1994). While negative symptoms involve loss of interest, motivation, affect, pleasure, and mental content (Galderisi et al., 2018), positive symptoms (hallucinations, delusions) and conceptual disorganisation are characteristic of psychosis (Gaebel and Zielasek, 2022).

Recent theories propose that many psychiatric symptoms may be manifestations of deeper core alterations in the temporal dimension (Kent et al., 2022). The psychological perception of time by patients with schizophrenia is characterised by temporal fragmentation, disorganisation of the present, unreliable priors/predictions of future events, and déjà vu/déjà vecu (Northoff, 2015; Stanghellini et al., 2015; Vogel et al., 2019). Beyond the momentary integration of the past, present, and future proposed by Husserl, also known as specious present (Gallagher, 2017), the three time modes can be experienced on a more extended narrative timescale (Varela, 1999).

In recent decades, the analysis of psychological time has been expanded by considering temporal perspectives within this larger timescale (Carstensen et al., 1999). The theoretical framework proposed by Zimbardo and Boyd (Stolarski et al., 2015; Zimbardo and Boyd, 1999) has gained the attention of both researchers and practitioners from various areas of behavioural science and medicine. The authors, building upon the classic Lewin's (1951) approach, defined the concept of *time perspective (TP)* as the *"nonconscious personal attitude that each of us holds towards time and the process whereby the continual flow of existence is bundled into time categories that help to give order, coherence, and meaning to our lives"* (Zimbardo and Boyd, 2008). Considering the three-time modes and their affective valence, Zimbardo and Boyd introduced five basic time perspective dimensions: Past-Positive, Past-Negative, Present-Fatalistic, Present-Hedonistic, and Future. A combination of these features provides a detailed (albeit not necessarily exhaustive – see e.g., Stolarski et al., 2018) picture of individual differences in the process of temporal framing of personal experience. (Zimbardo and Boyd, 1999) further highlighted the regulatory role of temporal perspectives by emphasizing the pronounced adaptive consequences of the *"ability to switch effectively between temporal horizons in response to situational and environmental demands"* (Stolarski et al., 2020) referred to as Balanced TP. Despite the importance of balanced TP for psychological well-being and mental health (Stolarski et al., 2020), temporal disbalances on the extended narrative timescale in schizophrenia and other severe psychotic disorders have only been investigated by preliminary studies (Oyanadel et al., 2014; Styła et al., 2019; Van Beek et al., 2011). Besides, the only study linking TPs with schizophrenia symptoms (Styła et al., 2019) was a brief report carried out on a small sample (45 patients and 45 controls). In this study, the authors focused solely on temporal balance and reported only the associations with the global DBTP score. The authors reported a marked effect of DBTP on the diagnosis of a schizophrenia spectrum ($r = 0.40$), showing that temporal balance mediates between childhood adversities and both diagnosis and poor global functioning among patients. Therefore, the relationship between temporal imbalance and the clinical manifestation of psychotic conditions remains unclear.

1.1. The present study

This study is part of the DiAPAson project (see also D'Anna et al., 2023; de Girolamo et al., 2020; Martinelli et al., 2023; Mayeli et al., 2023; Oliva et al., 2022; Zarbo et al., 2022; Zarbo et al., 2023), a 3-year multicentric Italian project aimed at 1) evaluating the daily time use among patients with SSD living in Residential Facilities compared to outpatients with SSD and to the general population, as well as assessing the relationship between the severity of psychiatric symptoms and the amount of time spent doing nothing and time perception (Study 1); (2) evaluating the quality of staff-patient relationships, its association with specific patient outcomes and the quality of care provided in RFs (Study 2); and (3) assessing daily activity patterns in residential patients, outpatients with SSD and healthy controls using real-time methodologies (Study 3).

As part of this project, the primary aim of the present work was to explore the associations between severity of psychiatric symptoms and Deviation from the Balanced TP (DBTP) in a large sample of patients with schizophrenia spectrum disorder (SSD). Considering the maladaptive nature of temporal disbalance (Stolarski et al., 2020; Zimbardo and Boyd, 2008), we expected to find a consistent positive relationship between DBTP and the overall clinical severity of SSD. The secondary aim was to conduct in-depth explorations of the relationship between temporal perspectives and primary/secondary SSD symptoms.

2. Methods

This observational study is compliant with the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines (Von Elm et al., 2007) (eTable 1). All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the revised Helsinki Declaration, 2008.

2.1. Participants and procedure

The inclusion criteria were as follows: DSM-5 diagnosis of SSD (American Psychiatric Association, 2013), age between 18 and 55 years, and either to be treated in one of the 37 participating centres as an outpatient or at a residential facility. Detailed information on the study setting, sample selection and inclusion/exclusion criteria is provided in eMethods. The final sample comprised 620 patients with SSD.

At each study centre, treating clinicians invited eligible participants under their care to participate in the study. The participants were provided with detailed information about the study and had the opportunity to ask questions. Some of the assessment tools (socio-demographic/clinical surveys) were completed by the treating clinician, while research assistants helped the patients complete a range of self-reported questionnaires.

2.2. Assessment tools

Several data were collected for each patient (see the study protocol for a complete list; De Girolamo et al., 2020). In the present study, we reported demographic information (e.g., sex, age, years of education, diagnostic category, number of psychotropic medications (antipsychotics, antidepressants, mood stabilizers) and the following measures:

2.3. Zimbardo Time-Perspective Inventory (ZTPI)

The Zimbardo Time Perspective Inventory (ZTPI) (Zimbardo and Boyd, 1999) is a 56-item, self-administered questionnaire that evaluates subjective time perspective via five subscales. Each of these scores can deviate from the ideal value (depicted in the balanced TP profile) which is associated with a higher quality of life and functional adaptation in the general population. Hence, the ZTPI scores allow the calculation of a joint indicator of temporal maladaptation, DBTP. This study adopted the DBTP revised score (DBTP-r) (Jankowski et al., 2020), the most accurate proxy of unbalanced TPs to date (McKay et al., 2022). DBTP proved to be

a valid predictor of both psychological well-being (Zhang et al., 2013) and a variety of outcomes indicating socioemotional adaptation (Stolarski et al., 2020):

Domain	Ideal score
Future (F)	5.0
Past-Positive (PP)	5.0
Present-Hedonistic (PH)	3.4
Past-Negative (PN)	1.0
Present-Fatalistic (PF)	1.0

The DBTP-r is defined as the Euclidean distance between the optimal and empirical levels of the time perspective:

$$DBTP_r = \sqrt{(1-ePN)^2 + (5-ePP)^2 + (1-ePF)^2 + (3.4-ePH)^2 + (5-eF)^2}$$

Hence, higher DBTP-r scores indicate poorer temporal balance. This test has been validated in Italian (Martoni et al., 2023).

2.4. Brief Psychiatric Rating Scale (BPRS)

The BPRS is a 24-item clinician-rated scale used as an indicator of global psychopathology. The total score can also be divided in four subscales (Varner et al., 2000): thought disturbances (TD); withdrawal/retardation (WR), hostility-suspiciousness (HS), and anxiety/depression (AD). The BPRS items were rated on a seven-point scale ranging from 1 (not present) to 7 (extremely severe). Higher total scores indicate higher symptom severity. We adopted the Italian version of the BPRS 4.0 (Roncone et al., 1999).

2.5. Brief Negative Symptoms Scale (BNSS)

This assessment tool specifically focuses on primary negative symptoms, which are more strongly associated with a negative prognosis and lower quality of life than other schizophrenia symptoms (Fusar-Poli et al., 2015). The BNSS (Strauss et al., 2012) is a 13-item clinician-rated scale indicating the severity of six domains: anhedonia, lack of normal distress, asociality, avolition, blunted affect, and alogia. The BNSS items were rated on a seven-point scale ranging from 0 (not present) to 6 (severe deficit). Higher total scores indicate higher symptom severity. BNSS has also been validated in Italian (Mucci et al., 2015).

2.6. Outcome measures and analysis design

The association of ZTPI scores (DBTP-r and five basic temporal perspectives) with the BPRS and BNSS total scores was analysed as the primary outcome, hypothesizing a positive correlation between unbalanced TPs and clinical symptoms.

The present study aimed to provide a fine-grained exploration of the temporal and clinical psychopathological dimensions with their secondary outcomes: (a) to measure associations between TPs and BPRS subscales (e.g., thought disturbances, withdrawal/retardation, hostility/suspiciousness, and anxiety/depression) and BNSS subscales (e.g., anhedonia, lack of normal distress, asociality, avolition, blunted affect, and alogia). Both thought disturbances (primary/diagnostic SSD features) and anxiety/depression (secondary/non-diagnostic SSD features) scores were positively correlated with DBTP-r scores. The potential moderating effect of DBTP-r on the correlation between the primary and secondary SSD features was tested as a post-hoc analysis. (b) While single negative symptoms are taken into account in BNSS subscale scores, BPRS single items can be leveraged to test whether ZTPI scores are associated with specific psychotic symptoms. Patients were divided according to the presence or absence of hallucinations, delusions, or conceptual disorganisation, as rated by specific BPRS items (see Methods for cut-off selection criteria). Then, differences in DBPT-r and

each of the five TPs were computed for each symptom, comparing the group with and without that particular symptom.

2.7. Sensitivity analyses

Correlations between total and subscale scores were computed within each scale (e.g., ZTPI, BNSS, and BPRS) to assess the reliability of clinical evaluations and to allow a comparison with other studies. To better describe the clinical sample, patients were divided according to their diagnosis (schizophrenia, schizoaffective, or other), and the Kruskal-Wallis analysis was performed to analyse the differences in demographic, temporal, and clinical features. Post hoc Bonferroni corrections were applied for pairwise comparisons.

The correlations between age and ZTPI scores were also computed as Spearman's Rho coefficients to assess whether temporal perspectives may change throughout the patients' lifespan. Significant associations were further explored with regression plots.

2.8. Statistical analyses

All correlations were computed using Pearson's r coefficients and are displayed as correlation matrices. Due to the presence of multiple comparisons, thresholds for statistical significance were set at a Holm-Bonferroni corrected $p = 0.05$ (Abdi, 2010). Aside from significance, a particular emphasis in the discussion has been given to results with $r \geq 0.2$, as lower correlation strengths are often considered poor or negligible (Akoglu, 2018). For secondary aim (b), normality was tested using the Kolmogorov-Smirnov test (Lilliefors, 1967). Due to uneven distributions of ZTPI scores in the patient subgroups, Mann-Whitney U tests were used to test for the presence of between-group differences. To examine the moderating role of DBTP-r on the effect of BPRS-AD on BPRS-TD, we computed a moderation model using the SPSS PROCESS V4.0 macro (Hayes and Rockwood, 2017). All analyses were conducted using the R software (Team R Core, 2013) and SPSS (Version 27.0; IBM Corp., Released 2020, IBM SPSS Statistics for Windows, Armonk, NY, USA).

3. Results

Full assessments for 620 patients (68 % males, mean age = 41.3 ± 9.5 years) with a diagnosis of SSD were available (Table 1).

3.1. Primary outcome: relationships between ZTPI and BNSS/BPRS total scores

Low-to-moderate positive correlations were found between DBTP-r and BPRS/BNSS total scores ($r = 0.29$ and 0.22, respectively, corrected $p < 0.001$). The Past-Negative and Present-Fatalistic were correlated with higher BNSS/BPRS scores, whereas Past-Positive and Future TP were associated with lower BPRS/BNSS scores (Fig. 1).

3.2. Secondary outcome (a): relationships between ZTPI and BPRS/BNSS subscales

These results mirrored the trends observed for the total scores. Interestingly, the strongest association between DBTP-r and BPRS subscales was visible for the anxiety/depression dimension ($r = 0.34$, corrected p < 0.001) rather than schizophrenia-specific symptoms. However, the association between DBTP-r and thought disturbances was also significant ($r = 0.20$, corrected $p = 0.001$). Among specific TPs, Past-Negative was selectively associated with the anxiety/depression dimension ($r = 0.36$, corrected p < 0.001), whereas Present-Fatalistic was selectively associated with the thought disturbances dimension (r = 0.20, corrected p = 0.001). Concerning BNSS, DBTP-r was especially associated with the anhedonia and avolition subscales ($r = 0.21$ and 0.24, respectively, corrected p < 0.001; Fig. 2).

Table 1
Sociodemographic and clinical characteristics of the sample.

Variable	Mean value
Males, N (%)	422 (68.1 %)
Age, mean	41.3 (9.5)
Education years, mean	11.7 (3.1)
N of antipsychotics, mean	1.6 (0.8)
N of antidepressants, mean	0.3 (0.5)
N of mood stabilizers, mean	0.3 (0.5)
DBTP-r, mean	4.1 (0.8)
ZTPI Future, mean	3.5 (0.5)
ZTPI Past-Positive, mean	3.3 (0.7)
ZTPI Present-Hedonistic, mean	3.2 (0.6)
ZTPI Past-Negative, mean	3.5 (0.7)
ZTPI Present-Fatalistic mean	2.9 (0.7)
BPRS total score, mean	46.9 (14.8)
BPRS thought disturbances, mean	6.5 (3.3)
BPRS withdrawal/retardation, mean	6.5 (3.2)
BPRS hostility/suspiciousness, mean	6.0 (2.8)
BPRS anxiety/depression, mean	7.5 (3.3)
BNSS total score, mean	22.8 (15.7)
BNSS anhedonia, mean	5.5 (4.6)
BNSS distress, mean	1.8 (1.7)
BNSS asociality, mean	4.1 (3.1)
BNSS blunted affect, mean	4.8 (4.6)
BNSS avolition, mean	3.8 (3.1)
BNSS alogia, mean	2.9 (3.1)

Note: BPRS: Brief Psychiatric Rating Scale. BNSS: Brief Negative Symptoms Scale. ZTPI: Zimbardo Time Perspective Inventory.

The analyses provide reliable evidence about the specific association between DBTP-r and both thought disturbances and anxiety/depression BPRS scores. We then tested the moderating effect of DBTP-r between thought disturbances and anxiety/depression, hypothesizing that unbalances in TPs may impact the relationship between thought and affective disorders in patients with SSD. The results of this analysis were significant: the higher the DBTP-r, the less the two clinical dimensions were associated ($\beta = -0.107$, $p = 0.033$, see Fig. 3).
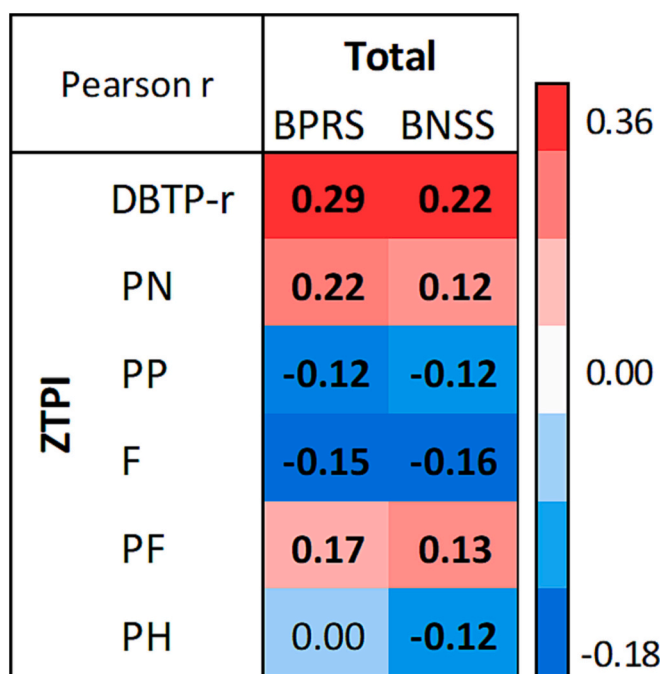
3.3. Secondary outcome (b): ZTPI differences in patients with/without hallucinations, delusions, and conceptual disorganisation

DBTP-r was higher in patients with hallucinations, delusions, or conceptual disorganisation (effect size = 0.391, 0.293, and 0.397, respectively), although significance did not survive the Holm-Bonferroni correction for delusions. When compared to patients without current psychotic symptoms, patients with hallucinations showed reduced Future and increased Present-Fatalistic perspectives (effect size = 0.387 and 0.261, respectively), while patients with conceptual disorganisation exhibited increased Past-Negative and Present-Fatalistic perspectives (effect size = 0.301 and 0.423, respectively). Temporal perspectives were not altered in patients with delusions compared with patients who did not show this psychotic symptom (Table 2).

3.4. Sensitivity analysis

As expected, all within-scale correlations were significant (corrected $p < 0.01$). However, while the BNSS and BPRS showed moderate-to-high intercorrelations, the ZTPI domains were more independent, as they showed low-to-moderate correlations. Full tables with coefficients and p-values are displayed in eFigures 1–3.

SSD diagnostic categories showed significant differences in DBTP-r and Past-Positive scores, but their magnitude was low and very unlikely to be relevant at the clinical level. More substantial differences were present in the BPRS thought disturbances (schizophrenia = 6.7 > other SSD = 5.9) and anxiety/depression (schizoaffective/other SSD = 8.4/8.1 > schizophrenia = 7.0) scores. These differences, together with an increased mean number of mood stabilizers prescribed to patients

Pearson r	Total	
ZTPI	BPRS	BNSS
DBTP-r	0.29	0.22
PN	0.22	0.12
PP	-0.12	-0.12
F	-0.15	-0.16
PF	0.17	0.13
PH	0.00	-0.12

Holm-corrected p	Total	
ZTPI	BPRS	BNSS
DBTP-r	<0.001	<0.001
PN	<0.001	0.014
PP	0.011	0.012
F	0.001	<0.001
PF	<0.001	0.004
PH	0.942	0.016

Fig. 1. Correlations (Pearson's r coefficients and Holm-Bonferroni corrected *p* values) between ZTPI and total BPRS/BNSS scores. ZTPI: Zimbardo Time Perspective Scale; DBTP-r: Deviation from the Balanced Time Perspective revisited score; PN: Past-Negative; PP: Past-Positive; F: Future; PF: Present-Fatalistic; PH: Present-Hedonistic.

with schizoaffective disorder than for schizophrenia/other SSD (0.6 vs. 0.3/0.2), were consistent with the diagnostic and treatment criteria of each category (eTable 2).

Regarding correlations of ZTPI scores with age, although imbalances in the Future ($r = 0.12$, $p = 0.003$) and Present-Fatalistic ($r = 0.19$, $p < 0.001$) dimensions significantly increased with age, this magnitude was always below the 0.2 threshold for the strength of associations (eTable 3). Due to the borderline magnitude of the correlation between Present-Fatalistic and age, this association was plotted in eFigure 4. Age,
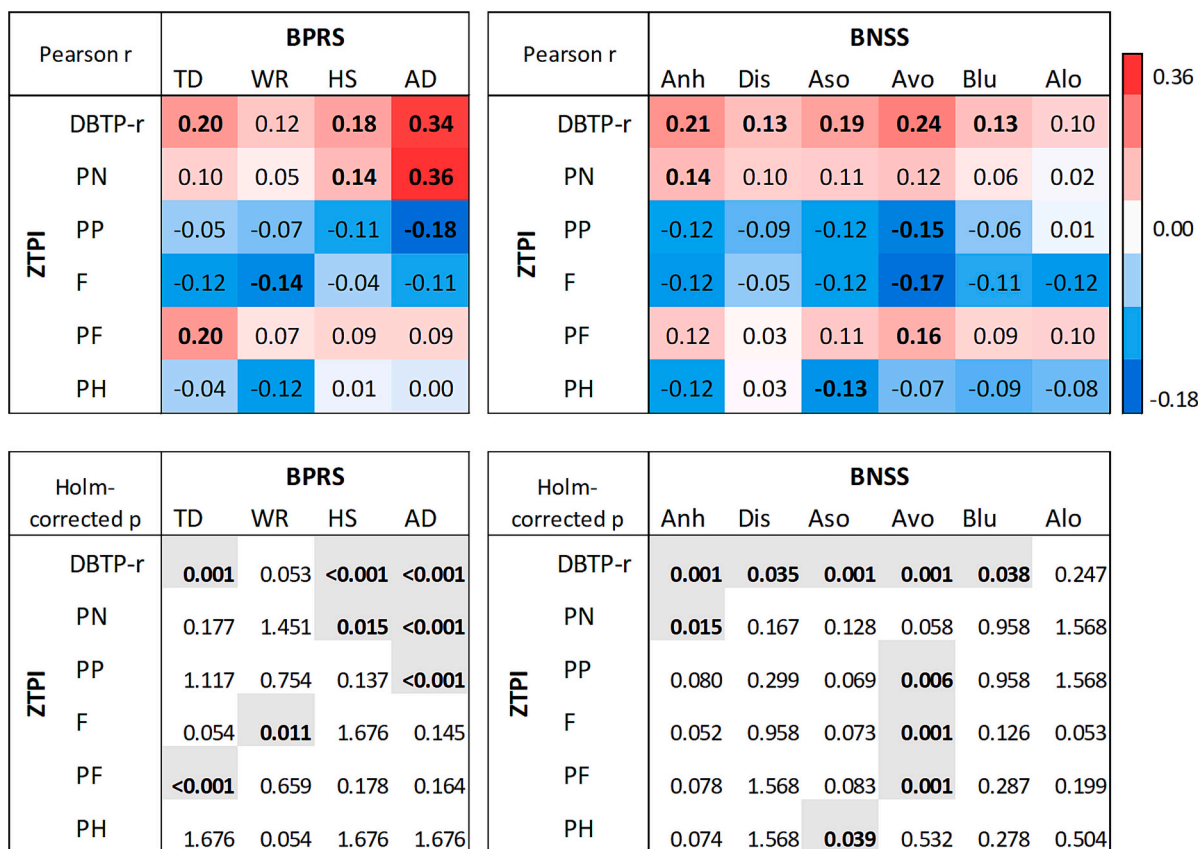
Fig. 2. Correlations (Pearson's r coefficients and Holm-Bonferroni corrected p values) between ZTPI and BPRS/BNSS subscales. For BPRS – TD: thought disturbances; WR: withdrawal/retardation; HS: hostility/suspiciousness; AD: anxiety/depression. For BNSS – ANH: anhedonia; DIS: lack of normal distress; ASO: asociality; AVO: avolition; BLU: blunted-affect; ALO: alogia.

as a variable, explained only a modest proportion of Present-Fatalistic variance, as evidenced by R-squared values of 3.8 %.

4. Discussion

Schizophrenia has long been considered a disorder in which time experience plays a central role in both phenomenology and neuroscience (Vogeley and Kupke, 2007). The present study is the first to analyse the associations between temporal and clinical dimensions in a large sample of patients with SSD. The unbalanced TP (DBTP-r), combining the disbalances in the five temporal perspectives, was the parameter that showed the most consistent associations with the clinical severity of SSD symptoms.

4.1. Unbalanced TP and general psychopathology

Our study highlights the relationship between disbalances in the temporal perspective and the severity of psychiatric symptoms in people with SSD, particularly thought disturbances and anxiety/depression. Similar to previous studies conducted on general population samples, DBTP-r was moderately linked to neuroticism and anxiety/depression severity (McKay and Cole, 2021; Stolarski et al., 2020). Similar strengths of association between DBTP and depressive symptoms were found in a psychiatric sample, but patients with schizophrenia were not assessed separately from other diagnostic groups (Oyanadel and Buela-Casal, 2014). Our findings show that the intertwining of unbalanced TP and the affective dimension (Stolarski et al., 2014) is also valid for SSD, suggesting that TP disbalances and anxiety/depression pertain to similar psychopathological dimensions.

We also showed that TP not only links with the anxiety/depression dimension but also moderates how these symptoms are related to the core psychotic features of SSD. The relationship between the severity of thought disturbances and anxiety/depression was reduced in patients with a more unbalanced TP. This moderating effect suggests that the core SSD feature, represented by thought disorders, tends to decouple from the affective dimension in the presence of severe TP alterations. This effect offers an additional explanation. As shown in Fig. 2, the association between DBTP-r and anxiety/depression was weaker when thought disturbances were high. This association may be a consequence of self-disorders (including a less consistent self-schema) that are predominant in patients with severe psychotic symptoms. Introducing the TP component in future studies may deepen our understanding of the complex interactions between depression and schizophrenia, which share very high comorbidity rates and negative past experiences as common risk factors (Upthegrove et al., 2017).

Notably, Past-Negative TP showed the highest load on the anxiety/depression domain ($r = 0.36$) among the single temporal dimensions. This finding is consistent with other results that highlight the strongly affective nature of this temporal perspective (Kaya Lefèvre et al., 2019; Stolarski et al., 2014). This effect may stem from at least three mechanisms. First, patients with SSD are more exposed to aversive past experiences owing to increased stigma and vulnerability to negative life events (Norman and Malla, 1993). Second, they might have experienced elevated childhood adversities which might have influenced both the negative perception of the past and severity of affective symptoms (Styła et al., 2019). Finally, they show a reduced ability to coherently process the present owing to the intrinsic features of the primary symptoms, which we explored.
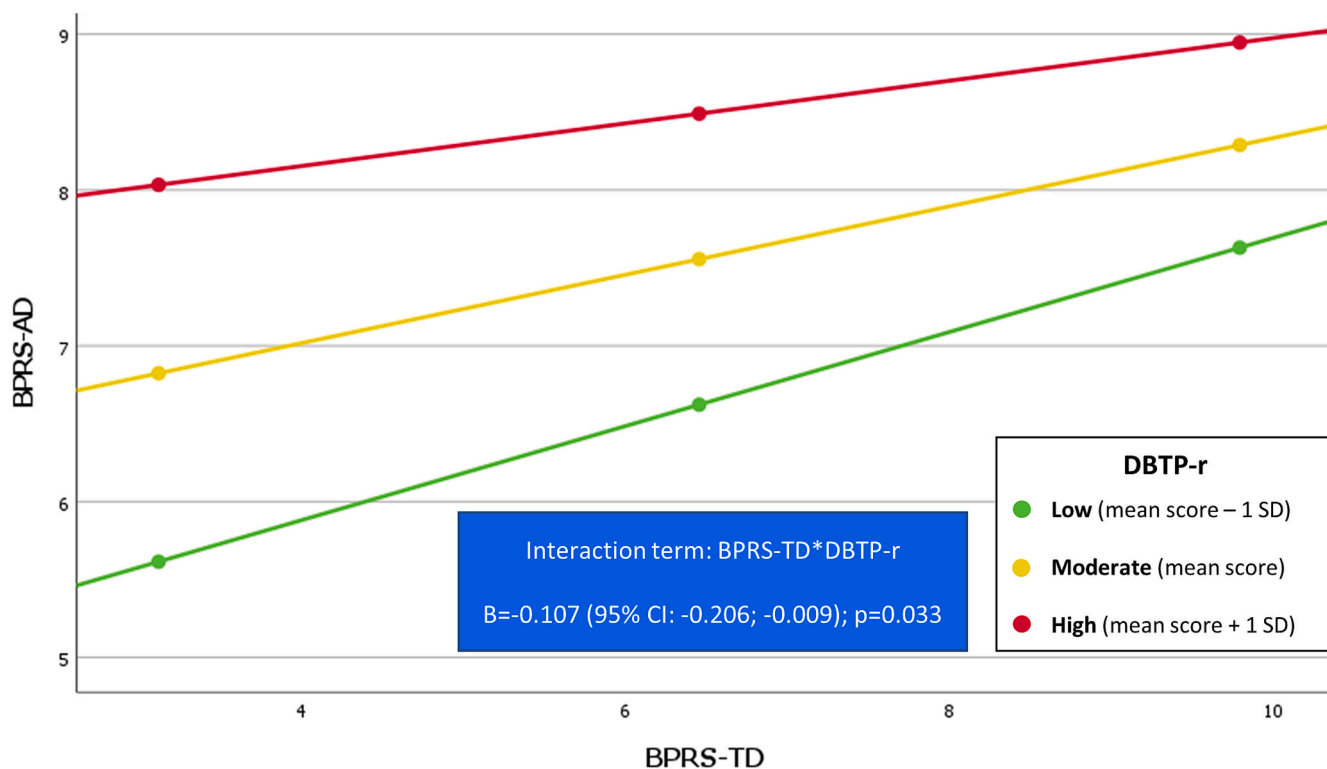
Fig. 3. Model investigating the moderating role of deviation from the balanced time perspective (DBTP-r) score in the relationship between primary (thought disturbances) and secondary symptoms (anxiety/depression) in patients with schizophrenia spectrum disorders.

Note: patients were divided according to their relative DBTP-r score compared to the score of the whole sample. Low, moderate and high DBTP-r groups are indicated as "mean DBTP-r value -1 SD", "mean value" and "mean value +1 SD" respectively. BPRS-TD: thought disturbances (e.g., hallucinations, unusual thought content and conceptual disorganisation) severity score; BPRS-AD: anxiety/depression severity score.

4.2. Unbalanced TP and negative/psychotic symptoms

In this study, we found that patients with more severe negative symptoms, especially those with avolition and anhedonia, were more unbalanced in their temporal perspectives. Both these symptoms may contribute to the crystallisation of a more inert and rigid temporal perspective. Avolition is linked by definition to the lack of drive and motivation towards future perspectives (Waltz and Gold, 2015), while anhedonia permeates temporal horizons not only for absent past or present emotions, but also for the reduced prediction and anticipation of future rewards (Barnes et al., 2014). Interestingly, we did not observe a strong association between TP and single negative symptoms. When single items exploring thought disturbances were considered separately, DBTP-r was significantly worse in patients with hallucinations and conceptual disorganisation, with low-to-moderate effect sizes.

The Present-Fatalistic TP was particularly correlated with the severity of thought disturbances and was more negatively biased in patients with hallucinations and/or conceptual disorganisation. Patients with hallucinations were less oriented towards the Future, whereas Past-Negative TP was more prominent in the presence of conceptual disorganisation. Thus, hallucinations and disorganisation are more associated with an increased negative rather than a reduced positive/hedonistic valence of the present and past horizons. Among the three time modes, the present focus can be particularly impaired, as patients with active psychotic symptoms experience both their inner thoughts and the surrounding environment as noisy and chaotic, with difficulties in attributing spatial and temporal coordinates to different stimuli (Damiani et al., 2022; Fusar-Poli et al., 2022). This ambivalence is linked to unreliable predictions and attributions of causality on short-term and immediate time scales (Damiani et al., 2020; Griffin and Fletcher, 2017). In an interesting work, Tschacher and Kupper found that positive symptoms were strongly associated with increased perceived causality,

while disorganisation was more linked to attenuated perceived causality (Tschacher and Kupper, 2006). Hence, the higher levels of Present-Fatalistic among patients with disorganisation seem to corroborate this result. When their psychological time is altered, it can become impossible for patients with SSD to determine cause-effect relationships that are usually instinctive and pre-attentional (Maeda et al., 2012).

A separate domain that may exert an important role in elucidating the association between TP and schizophrenia symptoms is the cognitive one. Temporal planning on the narrative time scale requires complex sets of neurocognitive skills that, in turn, differ according to the prominent symptoms shown by each individual. For example, impairments in cognitive tasks are less evident in patients experiencing delusions and hallucinations compared to individuals with disorganized thinking (O'Leary et al., 2000) or negative symptoms (Bozikas et al., 2004). How cognitive loads may modulate the relationship between time perspective and psychiatric symptoms is certainly an intriguing research question that warrants thorough investigation in future studies.

The vast majority of studies on schizophrenia - see (Thoenes and Oberfeld, 2017) for a meta-analysis - have focused on time integration deficits on the immediate time scale (Martin et al., 2014). These deficits refer to temporal associations made in the time span of a few seconds, which can be conceptualised as a specious present (Roselli, 2018). Our study suggests that the altered time experience in SSD extends beyond the specious present, thus involving a disbalance in the narrative interplay of past, present, and future perspectives. As a speculation, a persistent loosening of the immediate temporal associations may therefore recalibrate the balance between narrative temporal horizons, which was altered in our sample. In fact, *"we exist within a transparent web of time"* (Varela, 1999): studies where temporal alterations on different timescales are measured together may further unravel how these different threads interact to shape both typical and unbalanced time experience. On the clinical side, our findings pave the way to

Table 2
Time perspective differences between patients with and without psychotic symptoms.[a]

BPRS: Hallucinations

	Present (mean, 95 % CI)	Absent (mean, 95 % CI)	Effect size	U[b]	p	Corrected p
	N = 95	N = 525				
DBTP-r	4.3 (4.2–4.5)	4 (3.9–4.1)	0.391	33.812	**<0.001**	**0.001**
F	3.3 (3.2–3.4)	3.5 (3.4–3.6)	0.387	24.113	**0.003**	**0.015**
PP	3.2 (3.0–3.3)	3.3 (3.2–3.4)	0.17	26.892	0.159	0.477
PH	3.1 (3.0–3.2)	3.2 (3.1–3.3)	0.181	26.800	0.159	0.477
PN	3.5 (3.4–3.7)	3.5 (3.4–3.6)	0.129	33.140	0.19	0.477
PF	3.1 (2.9–3.2)	2.9 (2.8–3.0)	0.261	33.163	**0.012**	**0.048**

BPRS: Delusions

	Present (mean, 95 % CI)	Absent (mean, 95 % CI)	Effect size	U[b]	p	Corrected p
	N = 90	N = 530				
DBTP-r	4.3 (4.1–4.4)	4 (3.9–4.1)	0.293	29.655	**0.015**	0.090
F	3.4 (3.3–3.5)	3.5 (3.4–3.6)	0.16	25.452	0.236	0.380
PP	3.2 (3.1–3.4)	3.3 (3.2–3.4)	0.091	26,340	0.68	0.424
PH	3.2 (3.1–3.3)	3.2 (3.1–3.3)	0.017	27.239	0.974	0.708
PN	3.6 (3.4–3.7)	3.5 (3.4–3.6)	0.134	29.410	0.106	1.000
PF	3 (2.9–3.2)	2.9 (2.8–3.0)	0.196	30.064	0.076	1.000

BPRS: Conceptual disorganisation

	Present (mean, 95 % CI)	Absent (mean, 95 % CI)	Effect size	U[b]	p	Corrected p
	N = 69	N = 551				
DBTP-r	4.3 (4.2–4.5)	4 (4.0–4.1)	0.397	24.901	**0.003**	**0.015**
F	3.4 (3.3–3.5)	3.5 (3.4–3.5)	0.192	19.548	0.247	0.741
PP	3.3 (3.1–3.5)	3.3 (3.2–3.3)	0.007	21.635	0.725	1.000
PH	3.2 (3.0–3.3)	3.2 (3.1–3.2)	0.016	21.437	0.796	1.000
PN	3.7 (3.5–3.8)	3.4 (3.4–3.5)	0.301	24.616	**0.011**	**0.044**
PF	3.2 (3.0–3.3)	2.9 (2.8–3.0)	0.423	25.971	**<0.001**	**0.001**

Significant p values (< 0.05) are highlighted in **bold**.

[a] Single BPRS items of the thought disturbances domain are considered separately.

[b] Mann-Whitney U-tests. DBTP-r: deviation from the balanced time perspective revisited score; PN: Past-Negative; PP: Past-Positive; F: Future; PF: Present-Fatalistic; PH: Present-Hedonistic.

further research aiming at developing novel assessments based on dimensional models of psychiatry (Kelly et al., 2018) and tailoring trainings focused on balancing TPs among psychiatric patients (Feruglio et al., 2021; Mooney et al., 2021). Such interventions recently proved to exert highly desirable effects among healthy samples (Kuan and Zhang, 2022) and seem to be a promising alternative for TP-based psychotherapy (Zimbardo et al., 2012).

4.3. Limitations

The main limitation of this study was that no healthy subjects were included as the control group. However, a wide array of studies worldwide has adopted the ZTPI in the general population, demonstrating the reliability of this measure across countries (Sircova et al., 2014). As a reference, the mean DBTP-r values found in the two healthy groups of individuals were approximately 3.5–3.6. (McKay and Cole, 2021; Tomich et al., 2022), indicating that the patients with SSD that we investigated substantially deviated from this standard. Interestingly, a recent study reported the average ZTPI scores gathered in a large sample of the Italian population (N = 2295, 1326 women, age range 18–74 years) (Martoni et al., 2023). The temporal domains where patients in our sample seem to exhibit the greatest imbalances as compared to this general population sample are Past-Negative (SSD mean = 3.5 ± 0.7; general population mean = 2.88 ± 0.74) and Present-Fatalistic scores (SSD mean = 2.9 ± 0.7; general population mean = 2.46 ± 0.65). Of note, these two scores are the ones associated with more severe symptoms in our sample. However, future research is necessary to confirm this potential difference.

Another limitation is the time of data acquisition: patients were assessed between October 2020 and October 2021 during the COVID pandemic, which led to containment measures, including prolonged lockdowns and possible alterations in TP and psychiatric severity. Furthermore, the cross-sectional nature of the study limits the possibility of drawing conclusions about the direction of causality of the relationship between the study variables. Unlike the majority of other studies, this study combined ZTPI self-measurements with clinician-rated assessment tools. The significant findings, in spite of the different sources of evaluation, further support their validity. Finally, we did not control for personality traits in this study. Although several studies have demonstrated the incremental validity of TPs in predicting various outcomes over and above personality (see e.g., Stolarski and Matthews, 2016; Zhang and Howell, 2011), certain overlaps between these constructs do exist; hence, future studies should seek to replicate the current findings by considering this potential redundancy.

5. Conclusions

Unbalanced TPs weave intricate relationships with a wide array of primary and secondary features of the schizophrenia spectrum and are associated with more severe anxiety/depression and psychotic and negative symptoms. This finding may provide vital information for new interventions or modifications in existing treatment models. TP can be effectively changed via both individual psychotherapy and group-level training interventions, and TP-based therapies may foster rehabilitation programs for individuals with SSD, with promising outcomes in

terms of psychiatric severity and negative symptomatology (Oyanadel et al., 2014; Sword et al., 2015).

Ethics approval and consent to participate

The study has been approved by the ethical committees (Ecs) of the three main participating centres: EC of IRCCS Istituto Centro San Giovanni di Dio Fatebenefratelli (31/07/2019; no. 211/2019), EC of Area Vasta Emilia Nord (25/ 09/2019; no. 0025975/19), and EC of Pavia (02/09/2019, no. 20190075685); Ethical Approval was obtained also from ECs of all participating centres.

Declaration of competing interest

The authors declare none.

Data availability

Dataset referring to this manuscript is published with restricted access on Zenodo platform and accessible at this link: https://doi.org/10.5281/zenodo.6797480.

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Role of the founding source

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.schres.2023.09.016.

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