

# Scale for Space and Time Experience in Psychosis: Converging Phenomenological and Psychopathological Perspectives

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## Keywords

Psychosis · Schizophrenia spectrum disorders · Space and time experience in psychosis

## Abstract

**Introduction:** Abnormalities in the experience of space and time are fundamental to understanding schizophrenia spectrum disorders, but the precise relation between such abnormalities and psychopathological symptoms is still unclear. Therefore, the aim of our study was to introduce a novel scale for space and time experience in psychosis (STEP), specifically devised to assess schizophrenia spectrum disorders.

**Methods:** The STEP scale is a semiquantitative instrument developed on the basis of several items from previous scales and phenomenological reports addressing the experience of space and time. We applied the STEP scale to three groups of subjects (patients with schizophrenia spectrum disorders, patients with predominant affective symptoms, and healthy control subjects), to whom we also applied other more general psychopathological scales, such as the Positive and Neg-

ative Syndrome Scale and the Ego-Psychopathology Inventory. **Results:** Patients with schizophrenia spectrum disorders scored significantly higher on general psychopathological scales relative to subjects belonging to the other groups. The STEP scale provided good psychometric properties regarding reliability. We also tested convergent and divergent validity of the STEP scale and found that space and time subscale scores of STEP significantly correlated with each other, as well as with the remaining general psychopathological scores. **Discussion/Conclusion:** We introduced the STEP scale as a novel instrument for the assessment of experience of space and time. Its psychometric properties showed high validity and reliability to identify psychopathological symptoms and enabled to differentiate patients with predominantly psychotic symptoms from those with predominantly affective symptoms. The STEP scale provides a standardized measure for assessing disturbances in the experience of space and time. Furthermore, it probably represents a leap forward toward the establishment of an additional dimension of symptoms proposed as “spatiotemporal psychopathology.”

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## Introduction

According to Bleuler [1, 2] and Minkowski [3], autism is a key feature of schizophrenia. Autism is often discussed in psychopathology [4–13], but its precise characterization in the setting of schizophrenia spectrum disorders remains unclear.

Eugène Minkowski [3] pointed out the altered experience of space and time as a key feature of autism in schizophrenia, in keeping with the concept proposal of “rich autism” by Bleuler [1]. Actually, patients with schizophrenia experience a so-called “time fragmentation,” as well as difficulties in “synchronizing” with others at their present time. Such patients lack intentionality toward the external world and also present with abnormalities in the experience of space (e.g., abnormalities in the experience of interpersonal distance). These aberrant experiences in space and time might lead to a sort of detachment from reality. In other words, there is a “loss of vital contact with reality,” which can be considered as a core feature of autism in schizophrenia spectrum disorders.

Although there are descriptions regarding abnormal experience of time [14–16], standardized instruments quantifying the experience of space and time in schizophrenia spectrum disorders are lacking [12, 13]. In fact, several observations reporting an abnormal experience of time in schizophrenia have been reported, since the original description by Minkowski [14], many of which focusing on “time fragmentation.” Temporal fragmentation is indeed the most common abnormality related to the experience of time in schizophrenia, especially in patients with acute psychosis [14, 17]. By contrast, the phenomenological experience of space has been rather neglected [18]. Actually, the abnormal experience of space and time in schizophrenia spectrum disorders has not yet been properly addressed. In this sense, the phenomenological approach to space and time experience may provide a shared feature or “common currency” [19, 20] with analogous temporal and spatial changes at the neuronal level of the brain.

The Examination of Anomalous Self Experience [21] and the Examination of Anomalous World Experience [22] scales include questions on the experience of space or time, but no unified and systematic scale for the experience of space and time in schizophrenia spectrum disorders has yet been proposed. Therefore, the aim of our study was to introduce a novel scale for space and time experience in psychosis (STEP) targeting schizophrenia spectrum disorders. In addition, we explored how the STEP scale might help distinguishing subgroups of pa-

tients with schizophrenia spectrum disorders from those with predominantly affective symptoms and how this relates to other psychopathological dimensions (including ego disorder, positive, and negative symptoms).

We first introduce a detailed description of the STEP scale. Then, we report the results of an empirical investigation to validate the STEP scale in a small sample of subjects. Finally, we discuss the main features, advantages, and limitations of the proposed scale.

## STEP Scale

Table 1 summarizes items proposed to assess the experience of space (space subscale), and Table 2 summarizes items proposed to assess the experience of time (time subscale), using the STEP scale. The proposed items for the STEP space subscale are: item 1 (hyperreflectiveness of movements) [23], item 2 (body discoordination) [23], item 3 (disembodiment) [23], item 4 (lack of intentionality toward the external world) [21], item 5 (lack of internal intentionality) [21], items 6 and 7 (interpersonal distance too close and/or too distant) [12, 21, 22], items 8 and 9 (distance to physical objects and space too close and/or too distant) [22], item 10 (body fragmentation) [21], item 11 (space and world fragmentation) [22], item 12 (space and self-fragmentation) [unpubl. data], item 13 (sensory bombardment) [18], and item 14 (spatial disorientation) [18].

The proposed items for the STEP time subscale are: item 1 (present and future are dominated by the past) [24], item 2 (future directedness collapses, because past is overwhelming) [17], item 3 (present time experience) [17], item 4 (future time experience) [17], items 5 and 6 (time speed is slower and/or faster) [22], item 7 (time fragmentation) [14], item 8 (future premonitions) [14], item 9 (anisotropy) [21], item 10 (present time is felt as too much prolonged) [unpubl. data], and item 11 (time synthesis) [14].

## Material and Methods

### Participants

Thirty participants (mean age = 36 years; standard deviation [SD] = 7.4; 12 women) were recruited for the current study. Nine patients (mean age = 33 years; SD = 8.2; 2 women) had schizophrenia spectrum disorders, and their clinical profile of psychosis did not encompass a noticeable affective domain. Ten patients (mean age = 32 years; SD = 5.4; 6 women) had predominant affective symptoms, and their clinical profile did not encompass psychotic symptoms at all. We also included 11 healthy control subjects (mean age = 41 years; SD = 4.5; 4 women).

**Table 1. STEP space subscale**

Items	1. Hyperreflectiveness of movements	2. Body discoordination	3. Disembodiment	4. Lack of intentionality toward the external world	5. Lack of intentionality	6. Interpersonal distance too close	7. Interpersonal distance too distant	8. Distance to physical objects and space too distant	9. Distance to physical objects and space too close	10. Body fragmentation	11. Space and world fragmentation	12. Space and self-fragmentation	13. Sensory bombardment	14. Spatial disorientation
Description	Patients have to intensively concentrate on every single movement, because, otherwise, they are unable to fulfill their actions	Body actions are not synchronized and constituted as a whole, but rather pieced together as successions of singular, fragmented movements with rigid, angular, and slow features	Patients describe themselves as deanimated bodies (cyborgs) or disembodied spirits (scanners). They often experience themselves as robots or human machines, thus becoming passive spectators of their body	A pervasive or frequently recurrent sense of inexplicable mental or physical fatigue, dampening of immediate aliveness, diminished energy, spontaneity, lack of "Elan vital" (EASE 2.18)	A subjective disturbance of thought initiative, "thought energy" or intellectual purpose. Difficulties in planning and structuring a specific task such as cooking or writing (EASE 1.11)	Immediate feeling of being invaded, overrun, flooded, constrained, or threatened by others. To be somehow, in a passive, dangerously exposed position at the mercy of others. There might be emotional paroxysms. Even familiar people might be experienced as unfamiliar, strange, and threatening in touch (EASE 4.3 and 4.4); (ARS A2.1 and A3.1)	Feelings of being detached from others, such as feeling a sense of remoteness, rejection or even being ignored by others. Patients get too closed in their inner world (EASE 3.2)	External space and physical objects are perceived as too distant. Space might also be perceived as infinite, unreal, and threatening (EASE 1.4.2 and 1.8.5)	Space and objects are felt as too much closer. Sometimes, the patient is unable to determine where the body ends and the outside world begins. A physical intermingling, in which external objects seem to be inside or merged within the patient's body. In some cases, the patient might feel invaded by the outside world (EASE 1.7.1 and 1.17).	It may include the perception of construction of single body parts or the whole body/alternatively, those parts for the whole body/may be perceived as becoming thinner, shorter, enlarged, pressed down, or diminished. Also, body parts may be experienced as strange, alien, lifeless, isolated, separated from each other, putting everything together, as not existing. These can be accompanied by feelings of nonsense (EASE 1.4.2)	A scene, landscape, or the surrounding world loses its cohesive unity; objects seem to be isolated, disconnected from their context, and less meaningful. There are no longer related to one another or become literally separated. Patients may try to compensate the abnormalities by searching or putting everything together, irrespective of corresponding nonsense (EASE 1.4.2)	Emotions are projected into parts of the body. Emotional experiences may be felt as artificial. Because of these projections, the outside space may be experienced as disconnected from the patients	Patients feel the external space as too much stimulating and overwhelming. They feel confused and disoriented, because they seem to experience sensory "bombardment". In other words, patients experience too much stimuli from everywhere, at the same time	In a familiar location, subjects feel completely lost and disoriented. Spatial perspectives become misleading. These experiences are accompanied by subjective states of disorientation and confusion

Related reference	Hirjack D, Breyer T, Thomann PA, Fuchs T. Disturbance of intentionality: a phenomenological study of body-affecting first-rank symptoms in schizophrenia. <i>PLoS One</i> . 8(9):e73662. <a href="https://doi.org/10.1371/journal.pone.0073662">https://doi.org/10.1371/journal.pone.0073662</a>	Hirjack D, Breyer T, Thomann PA, Fuchs T. Disturbance of intentionality: a phenomenological study of body-affecting first-rank symptoms in schizophrenia. <i>PLoS One</i> . 8(9):e73662. <a href="https://doi.org/10.1371/journal.pone.0073662">https://doi.org/10.1371/journal.pone.0073662</a>	Hirjack D, Breyer T, Thomann PA, Fuchs T. Disturbance of intentionality: a phenomenological study of body-affecting first-rank symptoms in schizophrenia. <i>PLoS One</i> . 8(9):e73662. <a href="https://doi.org/10.1371/journal.pone.0073662">https://doi.org/10.1371/journal.pone.0073662</a>	Parnas et al. EASE. <i>Psychopathology</i> . 2005;38:236–258. <a href="https://doi.org/10.1159/000088441">https://doi.org/10.1159/000088441</a>	Parnas et al. EASE. <i>Psychopathology</i> . 2005;38:236–258. <a href="https://doi.org/10.1159/000088441">https://doi.org/10.1159/000088441</a>	Parnas et al. EASE. <i>Psychopathology</i> . 2005;38:236–258. <a href="https://doi.org/10.1159/000088441">https://doi.org/10.1159/000088441</a>	Sass et al. EAWE. <i>Psychopathology</i> . 50(1):10–54. <a href="https://doi.org/10.1159/0000454928">https://doi.org/10.1159/0000454928</a>	Sass et al. EAWE. <i>Psychopathology</i> . 50(1):10–54. <a href="https://doi.org/10.1159/0000454928">https://doi.org/10.1159/0000454928</a>	Parnas et al. EASE. <i>Psychopathology</i> . 2005;38:236–258. <a href="https://doi.org/10.1159/000088441">https://doi.org/10.1159/000088441</a>	Sass et al. EAWE. <i>Psychopathology</i> . 50(1):10–54. <a href="https://doi.org/10.1159/0000454928">https://doi.org/10.1159/0000454928</a>	Sass et al. EAWE. <i>Psychopathology</i> . 50(1):10–54. <a href="https://doi.org/10.1159/0000454928">https://doi.org/10.1159/0000454928</a>	Clinical descriptions from schizophrenic patients	Stanghellini G et al. Abnormal space experience in persons with schizophrenia: an empirical qualitative study. <i>Schizophrenia Bulletin</i> . 2020;46(3):530–539. <a href="https://doi.org/10.1093/schbul/sbz107">https://doi.org/10.1093/schbul/sbz107</a>
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STEP: space and time experience in psychosis; ARS, Autism Rating Scale; EASE, Examination of Anomalous Self Experience; EAWE, Examination of Anomalous World Experience.

**Table 2.** STEP time subscale

Item	1. Present and future are dominated by the past because the past is overwhelming	2. Future directedness collapses, because the past is overwhelming	3. Present time experience	4. Future time experience	5. Time speed is slower	6. Time speed is faster	7. Time fragmentation	8. Future premonitions	9. Anisotropy	10. Present time is felt as too much prolonged ("longer now")	11. Time synthesis
Description	Present and future are dominated by the past, mainly because of feeling guilt requiring punishment.	There is a disconnection between past and present/future, due to excess of traumatic memories or perplexity.	Present is experienced with difficulties of sharing a normal life with others, or with significant passivity.	Future is experienced as being very difficult, lacking any significance, or even felt as nonexistent, possibly because of worries and fears.	Time speed is slower than that perceived by others; slower in general (along with feelings of perplexity and meaninglessness) or even completely stopped (EAW 2.2.1). Here, the key feature is the loss of dynamics of time.	Time speed is experienced as faster across different levels (e.g., faster than that perceived by other people, faster in general, along with perplexity and meaninglessness) (EAW 2.1.1)	Time is experienced as fragmented, and with disconnection in its synthesis. This may manifest as time being felt as a series of photographs, along with feelings of astonishment and perplexity or even without any associated significance.	Future is experienced as a series of premonitions: sometimes something threatening is perceived as being about to happen, and other times future is felt as indifferent or even as nonexistent at all.	Mental time travelling (across past, present, and future) is difficult for patients, which have the feeling that they are stuck in the present and cannot synchronize with their environment.	Events in time, which are perceived by other people as distinct, are often felt by patients as similar and simultaneous.	Time synthesis is lost, because it seems that time is concentrated in the present moment.
Related reference	Thones S, Oberfeld D. Time perception in Depression: a meta-analysis. <i>Journal of Affective Disorders</i> . 2015;175:359-372. <a href="https://doi.org/10.1016/j.jad.2014.12.057">https://doi.org/10.1016/j.jad.2014.12.057</a>	Vogel et al. Disturbed time experience during and after psychosis. <i>Schizophrenia Research</i> . 2019;171-9. <a href="https://doi.org/10.1016/j.schres.2019.100136">https://doi.org/10.1016/j.schres.2019.100136</a>	Vogel et al. Disturbed time experience during and after psychosis. <i>Schizophrenia Research</i> . 2019;171-9. <a href="https://doi.org/10.1016/j.schres.2019.100136">https://doi.org/10.1016/j.schres.2019.100136</a>	Vogel et al. Disturbed time experience during and after psychosis. <i>Schizophrenia Research</i> . 2019;171-9. <a href="https://doi.org/10.1016/j.schres.2019.100136">https://doi.org/10.1016/j.schres.2019.100136</a>	Sass et al. EAW. <i>Psychopathology</i> . 50(1):10-54. <a href="https://doi.org/10.1159/000454928">https://doi.org/10.1159/000454928</a>	Sass et al. EAW. <i>Psychopathology</i> . 50(1):10-54. <a href="https://doi.org/10.1159/000454928">https://doi.org/10.1159/000454928</a>	Stanghellini G, et al. Psychopathology of lived time: abnormal time experience in persons with schizophrenia. <i>Schizophrenia Bulletin</i> . 2016;42(1):45-55. <a href="https://doi.org/10.1093/schbul/sbv052">https://doi.org/10.1093/schbul/sbv052</a>	Stanghellini G, et al. Psychopathology of lived time: abnormal time experience in persons with schizophrenia. <i>Schizophrenia Bulletin</i> . 2016;42(1):45-55. <a href="https://doi.org/10.1093/schbul/sbv052">https://doi.org/10.1093/schbul/sbv052</a>	Parnas et al. Examination of anomalous self experience (EASE). <i>Psychopathology</i> . 2005;38:236-258. <a href="https://doi.org/10.1159/000088441">https://doi.org/10.1159/000088441</a>	Kent, Nelson, and Northoff (unpubl. data)	Stanghellini G, et al. Psychopathology of lived time: abnormal time experience in persons with schizophrenia. <i>Schizophrenia Bulletin</i> . 2016;42(1):45-55. <a href="https://doi.org/10.1093/schbul/sbv052">https://doi.org/10.1093/schbul/sbv052</a>

STEP, space and time experience in psychosis; EAW, Examination of anomalous world experience.

The diagnosis of all patients was made in consensus by two psychiatrists at two outpatient clinics, taking into account the Diagnostic and Statistical Manual of Mental Disorders, fifth edition, criteria [25]. Eight patients with schizophrenia spectrum disorders were taking antipsychotic medication. Nine patients with predominant affective symptoms were taking antidepressants. One of these patients was also under a mood stabilizer. All patients were stable and at a chronic stage of their illness.

Inclusion criteria for patients were: fulfillment of Diagnostic and Statistical Manual of Mental Disorders, fifth edition, criteria, illness duration <10 years, as well as sufficient motivation, introspective skills, and appropriate language to enroll in the interview, based on the clinical impression of both psychiatrists.

Exclusion criteria were: neurological diseases, history of alcohol or substance abuse, intellectual disability, as well as changes in psychopharmacological medication or hospitalization in the 3 months prior to inclusion in this study. No patients under the age of 18, or above the age of 50 years, were included.

A written informed consent was obtained from all participants, after a complete explanation of the study design. The study was approved by the local ethics committee.

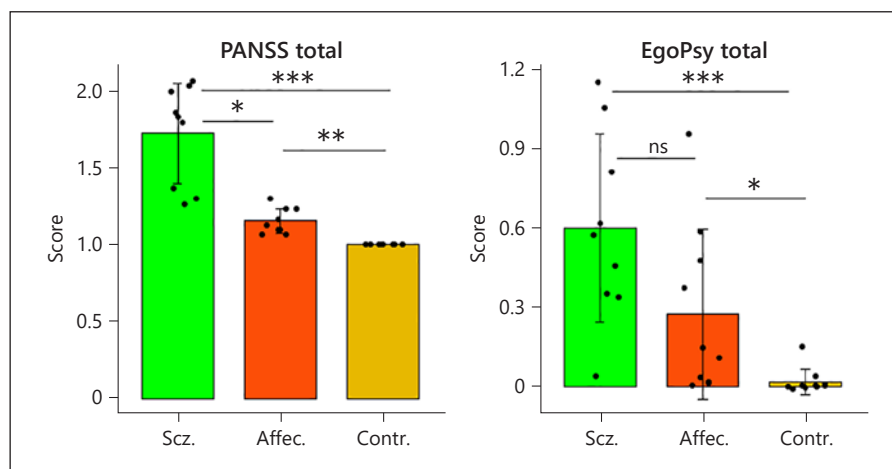
### Interview

The interview was conducted by the first author of the current study, in a semi-structured way, as an exploratory conversation, aiming at resembling the “therapeutic alliance” between patients and the psychiatrist. In other words, when the psychiatrist made a question, it never took the answer for granted without asking the question in different ways, allowing each participant to reformulate his or her own answers to different questions, examples, or even metaphors, but always keeping in mind the participant’s own words.

The interview always began with a general statement by the psychiatrist telling the participant that he or she should talk about the emotional, subjective, and practical descriptions of the experience of space and time. The psychiatrist used to inform that questions were difficult to answer, not because of difficulties related to the participants themselves. Instead, such difficulties were explained to be related to the abstract style of the questions. It was also pointed out that some answers were not easy to verbally communicate. The participants were informed that neither psychiatrists nor patients were acquainted with spontaneously talking about subjective experiences of space and time. In our view, these explanations were important, because they were meant to reduce the potential anxiety of participants during the interview, and helped to prevent high expectations from participants regarding the accuracy of their answers. In summary, there was an agreement between the psychiatrist and each participant that there were no right or wrong answers. Nevertheless, the interview included specific questions about the subjective experience of time, as suggested by Stanghellini et al. [14], in order to allow participants to get more familiar with such an assessment.

Afterwards, the time subscale of STEP was applied. The interviewer psychiatrist started by reading and presenting the items in a broad way, letting the participant spontaneously talk about what he or she thought about them. Sometimes, participants made their own questions, which the psychiatrist tried to answer in an understandable way. Then, the psychiatrist also provided some examples of situations with which the participant could (or could not) identify with. The score for each tested item was attributed by the psy-

**Fig. 1.** Bar plots for PANSS total and EgoPsy total. Error bars represent standard error. EgoPsy, Ego-Psychopathology Inventory; PANSS, Positive and Negative Syndrome Scale.



chiatrist, after taking together the abovementioned information. Finally, the space subscale of STEP was applied in a similar way. This subscale did not require a prior open questionnaire though, because the subjective experience of space was considered to be much easier to understand by the participants.

As previously mentioned in the introduction, the STEP scale consisted of the items presented in Tables 1 and 2. Each item was scored from 1 (absent) to 5 (severely present). On some items of the STEP scale, “severely present” actually means that the corresponding abnormality was present almost every day (i.e., the rating is about frequency). On other items of the STEP scale, the abovementioned expression refers to the most severe degree of psychopathology.

#### Additional Psychopathological Scales

We also applied the following psychopathological scales to all participants:

1. The Positive and Negative Syndrome Scale (PANSS) [26], a 30-item clinical scale that evaluates positive, negative, and general symptoms in schizophrenia. Each item was rated on a 7-point symptom severity scale, ranging from 1 (absent) to 7 (extremely severe).
2. Ego-Psychopathology Inventory [27], a 53-item clinical scale that evaluates identity, demarcation, consistency/coherence, activity, vitality, overcompensation, body, thought process, and psychomotor behaviors. Each item was rated on a 3-point severity scale, ranging from 0 (absent) to 2 (present one or more times).

#### Statistical Analyses

Statistical analyses were carried out using IBM SPSS software version 27 (<https://www.ibm.com/analytics/spss-statistics-software>). The significance level for all statistical comparisons was set at a  $p$  value  $<0.05$ . Scores were treated as continuous variables, to better illustrate the distribution of data, which was not normal. Therefore, we used nonparametric tests.

The Kruskal-Wallis test was used to compare all psychopathological scores among the three groups (patients with schizophrenia spectrum disorders, patients with predominantly affective symptoms, and healthy control subjects). We also used the Spearman’s

rank correlation coefficient ( $r_s$ ) to test associations among the STEP scale scores and the remainder psychopathological scores.

In order to validate the STEP scale, we used Cronbach’s alpha values as a measure of internal consistency, as well as convergent and divergent validity measures. For the latter, Bonferroni-corrected bivariate Spearman’s rank correlation coefficients were calculated, using the psych 2.1.3 package of R (<https://www.r-project.org/>) [28].

## Results

### *Differences between Patients with Schizophrenia Spectrum Disorders, Patients with Predominantly Affective Symptoms, and Healthy Control Subjects*

As expected, patients belonging to the schizophrenia spectrum disorders group were found to score significantly higher than subjects belonging to the remainder two groups in general psychopathological scales targeting schizophrenia, such as the PANSS ( $H = 26.711$ ,  $p < 0.001$ ) and the Ego-Psychopathology Inventory ( $H = 16.584$ ,  $p < 0.001$ ) Figure 1. The abovementioned preliminary results suggest that despite not being in the acute stage, patients belonging to the schizophrenia spectrum disorders group still displayed many typical features of psychosis.

### *STEP Total Scores*

Almost all patients with schizophrenia spectrum disorders scored higher in the STEP scale than subjects belonging to the remainder two groups. Crucially, this confirms the occurrence of major changes in the experience of space and time in patients with schizophrenia spectrum disorders.

**Table 3.** Convergent and divergent validity of STEP

	STEP space	STEP time	STEP space and time	STEP space SCZ	STEP time SCZ	STEP space and time SCZ
Cronbach's $\alpha$	0.903	0.873	0.940	0.756	0.826	0.867
Convergent validity						
PAUSS	0.78***	0.66***	0.75***	0.27 <sup>†</sup>	0.11 <sup>†</sup>	0.13 <sup>†</sup>
PANSS-negative	0.71***	0.57**	0.67***	-0.01 <sup>†</sup>	-0.01 <sup>†</sup>	-0.14 <sup>†</sup>
Divergent validity						
PANSS positive	0.42 <sup>†</sup>	0.39 <sup>†</sup>	0.39 <sup>†</sup>	0.05 <sup>†</sup>	-0.16 <sup>†</sup>	-0.1 <sup>†</sup>
Ego-psychopathology activity	0.72***	0.78***	0.8***	0.67 <sup>†</sup>	0.42 <sup>†</sup>	0.7 <sup>†</sup>
Ego-psychopathology thought process	0.65***	0.75***	0.74***	0.66 <sup>†</sup>	0.7 <sup>†</sup>	0.59 <sup>†</sup>

Bonferroni-corrected bivariate Spearman's rank correlation coefficients. The three left columns show the valid values for the total sample. The three right columns show results from patients with schizophrenia spectrum disorders ( $n = 9$ ) only. STEP, space and time experience in psychosis; PANSS, Positive and Negative Syndrome Scale. <sup>†</sup>  $p > 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

### *Internal Consistency and Validity of the STEP Scale*

Table 3 presents internal consistency values for the STEP scale and the corresponding subscales. In addition, convergent validity was confirmed for all scales. This means that our proposed scale correlates, as predicted, with stable (cf., permanent) abnormalities typical of schizophrenia spectrum disorders, such as negative symptoms. Space, time, and total STEP scores only showed divergent validity with respect to the PANSS positive scores. This means that our proposed scale does not correlate with symptoms of schizophrenia spectrum disorders that may vary along the clinical course of illness.

### *Space and Time STEP Subscales Discriminant Items*

Regarding the space subscale of STEP, patients belonging to the schizophrenia spectrum disorders group scored significantly higher than subjects belonging to the remainder two groups both in total and single items of the STEP space subscale. Regarding the latter, it should be pointed out that items 2, 4, 7, 12, 13, and 14 seemed to provide the best discriminant values between the schizophrenia spectrum disorders group and the remainder two (Fig. 2a).

Regarding the time subscale of STEP, patients belonging to the schizophrenia spectrum disorders group also scored significantly higher than subjects belonging to the remainder two groups, both in total and single items of the STEP time subscale. In particular, items 3, 5, 7, 8, and 9 seemed to provide the best discriminant values between the schizophrenia spectrum disorders group and the remainder two (Fig. 2b). Crucially, patients belonging to the predominantly affective group scored higher on item

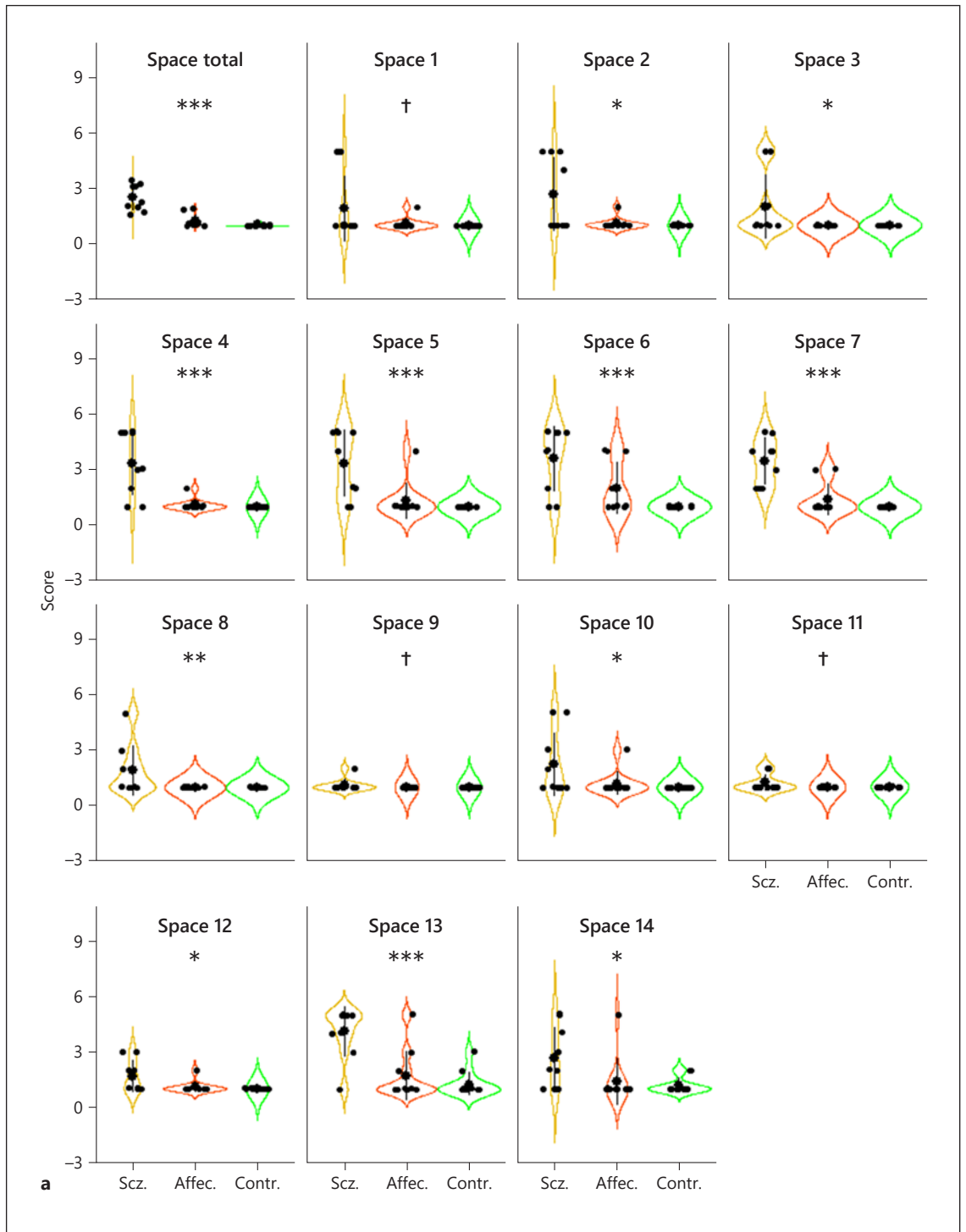
1 relative to patients with schizophrenia spectrum disorders.

### *Correlations among Space and Time Subscale and General Psychopathology Scores*

We found a strong and significant correlation between STEP space total and time total subscale scores ( $r_s = 0.79$ ;  $p < 0.001$ ) in all subjects. We also found a strong and significant correlation between the STEP space subscale and the PANSS total scores ( $r_s = 0.775$ ;  $p < 0.001$ ), as well as between the STEP space subscale and the Ego-Psychopathology Inventory total scores ( $r_s = 0.699$ ;  $p < 0.001$ ). Moreover, we found a strong and significant correlation between the STEP time subscale, the PANSS total ( $r_s = 0.845$ ;  $p < 0.001$ ), and the Ego-Psychopathology Inventory ( $r_s = 0.699$ ;  $p < 0.001$ ) scores. These preliminary findings suggest that changes in space and time experience are associated with an increased severity of psychotic symptoms. Partial correlations controlling for the predominant type of pathology are presented in Figure 3.

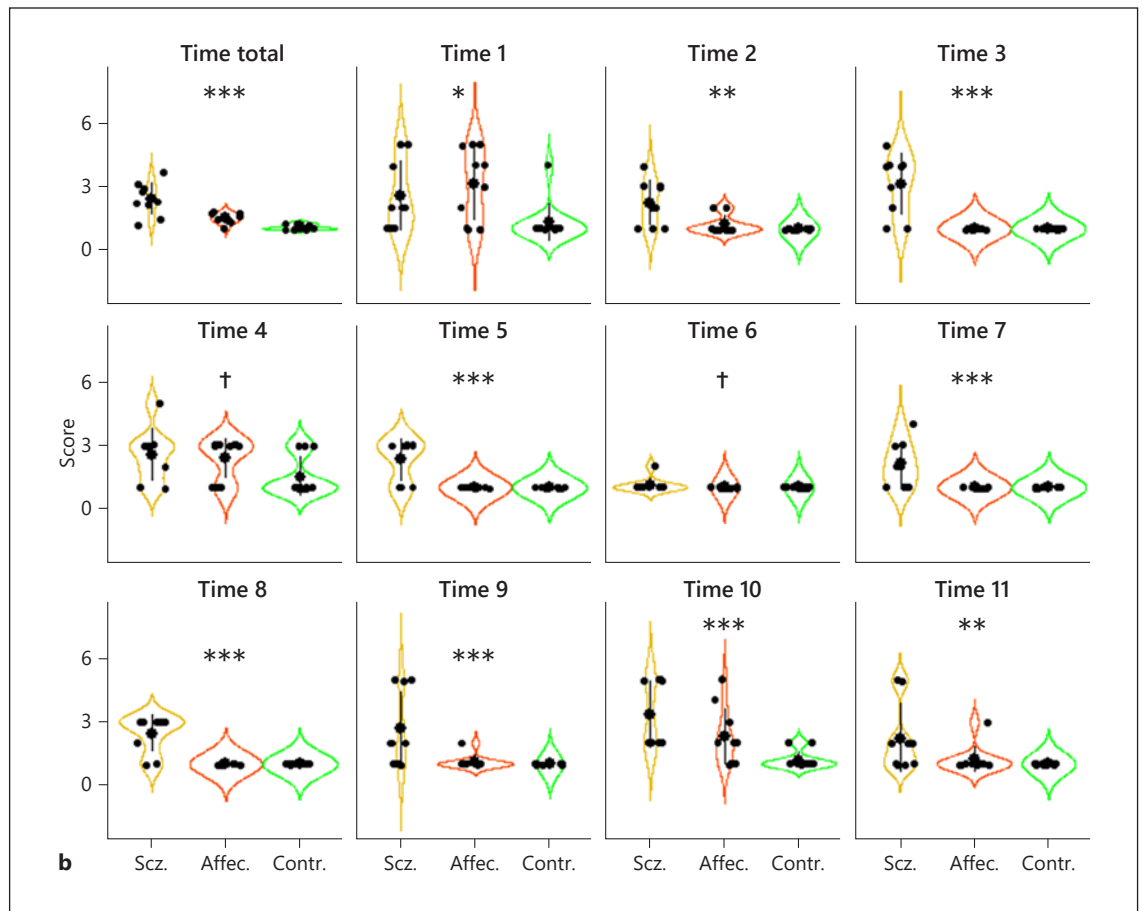
### **Discussion/Conclusion**

In this study, we introduced a novel scale to assess STEP. Our results showed a high validity and reliability for STEP. We also demonstrated that STEP can help differentiating patients with schizophrenia spectrum disorders from patients with predominant affective symptoms. Finally, we have found an association of STEP scores with the presence and severity of psychopathological symptoms. Taken together, our preliminary findings suggest



**Fig. 2.** Violin plots for each of the space (a) and time (b) items, as well as for the total STEP score. STEP, space and time experience in psychosis.

*(Figure continued on next page.)*



that STEP might be a useful measure for the assessment of schizophrenia spectrum disorders.

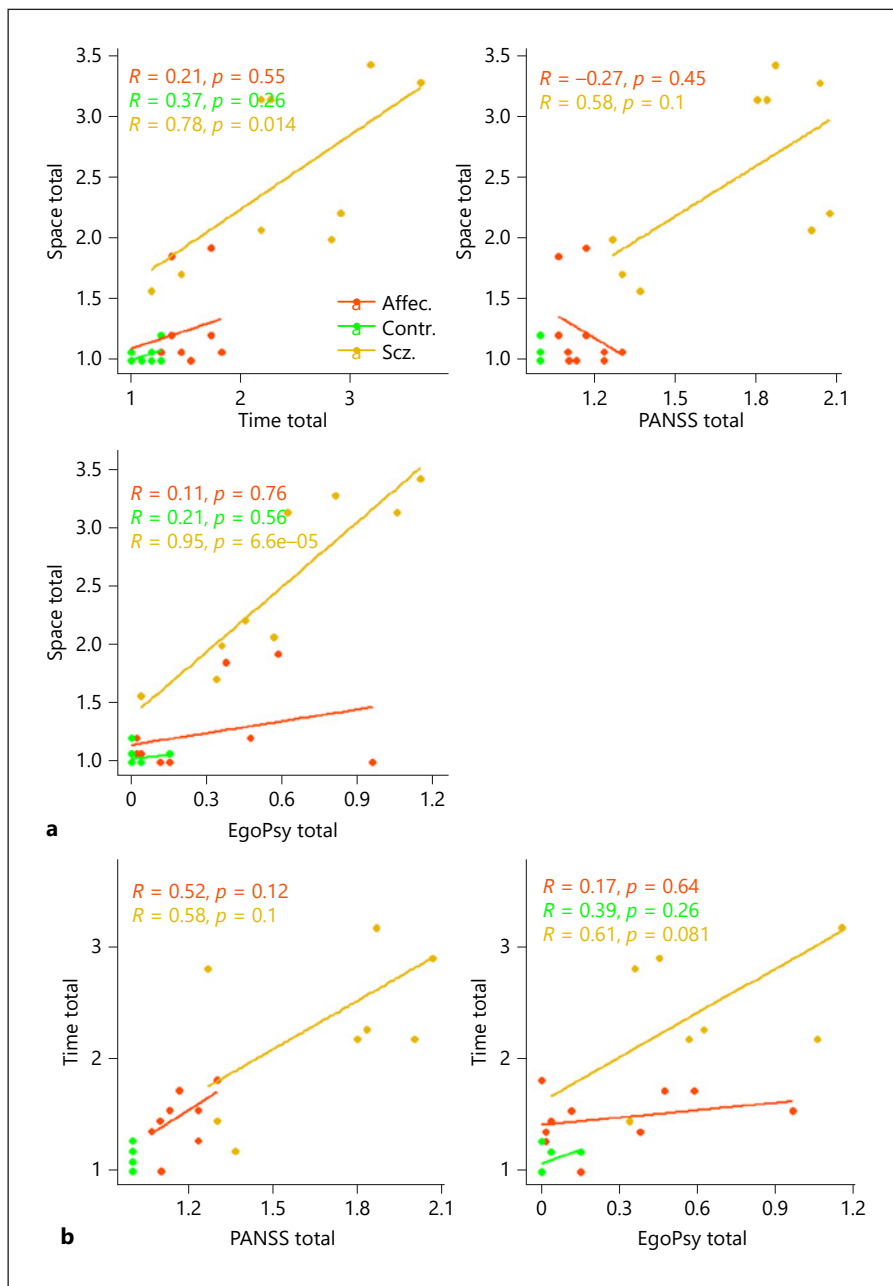
Regarding the experience of time in schizophrenia, it is noteworthy to point out that the items differentiating patients belonging to the schizophrenia spectrum disorders group from the other two groups were items 3, 5, 7, 8, and 9 of the STEP time subscale. Interestingly, these items correspond to the Minkowski's original description of schizophrenic autism. Explicit time desynchronization and autistic withdrawal may be a reaction to time disturbances. In particular, these items also resemble, in part, the proposals of Fuchs and Van Duppen [15] of implicit and explicit time disturbances in schizophrenia:

- Item 3 may resemble an explicit desynchronization from the social atmosphere;
- Item 5 may correspond to explicit retardation of time, specifically with feelings of perplexity and meaninglessness;
- Item 7 may resemble implicit and explicit time disturbances, such as fragmentation of the “intentional arc”;
- Item 8 may resemble implicit time disturbance or weakening of the protentional/retentional structure; and

- Item 9 may also correspond to what Ellenberger [29] describes as patients with schizophrenia feeling as being “fixed” in their present moment.

Similar observations were also found by Stanghellini et al. [18] in a semiquantitative study, particularly time fragmentation and future premonitions. Regarding the latter, Fuchs [15, 16] pointed out that protention is particularly altered in schizophrenia. Protention defines the probability of an event occurring in sequence to the present one. As such, protention relates to Fuchs's proposal [16] of a “cone of probability,” in which the determination of the next event becomes increasingly difficult when the former one vanishes as time goes by. In keeping with this proposal, the “cone of probability” is abnormally weakened and disrupted. By virtue of a loss in the “cone of probability,” patients with schizophrenia may remain unable to perform protention and, therefore, become unable to predict at an implicit time level. This is entirely consistent with schizophrenia deficits related to volatility of temporal prediction (at a millisecond range), as observed by Giersch's group [30–34]. Hence, what is described as





**Fig. 3.** Correlation between different scales and space total (a) and time total (b). Ego-Psy, Ego-Psychopathology Inventory; PANSS, Positive and Negative Syndrome Scale.

“temporal prediction of implicit time,” using the psychology language, may be related to the loss of protention and its “cone of probability” at the phenomenological level.

Regarding the experience of space in schizophrenia, our results show that the best single items to characterize patients with predominant psychotic symptoms were items 2, 4, 7, 12, 13, and 14 of the STEP space subscale. These results are also in line with a recent study by Stanghellini et al. [18]. In particular, item 7 may resemble the experience of “centrality/invasiveness of the peri-person-

al space” [18]. Interestingly, these authors pointed out that patients with schizophrenia need a wider interpersonal space while in social interaction [18]. Moreover, item 13 may correspond to “itemization and perceptive salience,” whereas item 14 may resemble “alteration of quality of the environment,” as proposed by the same authors [18]. Moreover, items 2, 4, and 12 of the STEP space subscale seem to be related to body disturbance, perceived as an “inner space” predisposing to space disturbances [18].

Furthermore, the abovementioned results might be understood through the lens of multisensory integration research. This concept considers the processing of a sensory input using various complementary modalities, the combination of which enabling to solve potential conflicts in representing the body and the world at a conceptual level [35]. In this sense, patients with schizophrenia seem to display a decreased sense of body ownership and an impaired capacity of self-other distinction, attributable to deficits in multisensory integration [35]. In other words, body discoordination, lack of intentionality toward the external world, interpersonal distance too distant, and self-space fragmentation might be conceptualized as a reduced multisensory integration secondary to a weakened body representation. Moreover, sensory bombardment and spatial disorientation might be caused by imprecise or unreliable internal predictions, which might predispose patients with schizophrenia to depend more intensively on aberrant salience of prediction errors related to perception [36, 37].

As previously mentioned, the STEP scale was grounded on the Examination of Anomalous Self Experience scale [21], the Examination of Anomalous World Experience scale [22], and the Autism Rating Scale [12, 13]. Nevertheless, several items of the STEP scale were slightly modified. For instance, items 1, 2, and 3 of the STEP space subscale were mainly grounded in qualitative research on body disturbance phenomena in schizophrenia [23], and item 12 was clearly inspired by our own observations and clinical experience.

Our study showed how important it is to revisit the concept of schizophrenic autism [38], not only according to the classical notions but also according to recent proposals by means of which abnormalities in space and time experience actually explain the detachment from reality of patients with schizophrenia [39].

The main limitation of our study was the small sample size. For this reason, it might be regarded as a pilot study conveying preliminary findings. The fact that all interviews were carried out by the first author of the current study might also be regarded as a limitation.

Our results seem to suggest that items 3, 5, 7, 8, and 9 of the STEP time subscale as well as items 2, 4, 7, 12, 13, and 14 of the STEP space subscale might be of particular interest in clinical practice. This can pave the way for a proposal of a short version of STEP. Further (pilot) studies are warranted to address this hypothesis.

In conclusion, we postulate that the STEP scale may become a standardized and quantifiable instrument to assess disturbances of space and time experience, or to as-

sess a so-called “spatiotemporal psychopathology” [40–42], which might become an additional dimension of symptoms or a “common currency” (cf., shared feature) [19, 20] among neural and mental features of psychosis, as investigated in phenomenology, psychology, and neuroscience (see online supplementary material 1 and 2, available at [www.karger.com/doi/10.1159/000519500](http://www.karger.com/doi/10.1159/000519500)).

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## Statement of Ethics

This study protocol was reviewed and approved by the Ethics Committee of the “Hospital de São João/Faculdade de Medicina da Universidade do Porto” (approval number 169-21). All participants gave their written informed consent after an oral and written explanation of the study.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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## Author Contributions

Filipe Arantes-Gonçalves performed all the interviews and wrote parts of the manuscript; Angelika Wolman wrote parts of the Methods and Results section and carried out statistical analyses; António José de Bastos-Leite supervised and critically thoroughly revised the final versions of the manuscript; Georg Northoff supervised the study design and suggested relevant literature. All authors approved the final version of the manuscript.

## Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material files. Further enquiries can be directed to the correspondent author.

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