Conversational metrics, psychopathological dimensions and Self disturbances in patients with schizophrenia

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Abbreviations:
ABaCO: Assessment Battery of Communication Scale
BTP: Between Turn Pauses
CLANG: Clinical Language Disorder Rating Scale
EASE: Examination of Anomalous Self Experience Scale
PANSS: Positive and Negative Syndrome Scale
SDs: Self Disturbances
SOFAS: Social and Occupational Functioning Scale
TLC: Thought, Language and Communication Scale

Abstract:
Introduction:
Difficulties in interpersonal communication, including conversational skills impairments, are core features of schizophrenia. However, very few studies have performed conversation analyses in a clinical population of schizophrenia patients. Here we investigate the conversational patterns of dialogues in schizophrenia patients to assess possible associations with symptom dimensions, subjective self-disturbances and social functioning.
Materials and methods:
Thirty-five schizophrenia patients were administered the Positive and Negative Syndrome Scale (PANSS), the Clinical Language Disorder Rating Scale (CLANG), the Scale for the Assessment of Thought, Language and Communication (TLC), the Examination of Anomalous Self Experience Scale (EASE), and the Social and Occupational Functioning Assessment Scale (SOFAS).
Moreover, participants underwent a recorded semi-structured interview, in order to extract conversational variables.
Results:
Conversational data were associated with negative symptoms and social functioning, but not with positive or disorganization symptoms. A significant positive correlation was found between “pause duration” and the EASE item “Spatialization of thought”.
Discussion:
The present study suggests an association between conversational patterns and negative symptom dimension of schizophrenia. Moreover, our findings evoke a relationship between the natural fluidity of conversation and of the natural unraveling of thoughts.

Keywords: schizophrenia, conversation, turn-taking, psychopathology, Self disturbances

Declarations

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Conflicts of interest/Competing interests:

Authors declared no potential conflict of interest with respect to the research, authorship and/or publication of this article.

Authors’ contributions:

VL conceived and designed the study, selected the patients, collected the data, undertook the statistical analyses, managed the literature searches and wrote the manuscript. FC conceived and designed the study and analyzed the data. BDD administered the EASE scale to patients. JL and FP selected the patients and collected the data. CC undertook the statistical analyses. CM, MG, KV conceived and designed the study. MT conceived and designed the study, selected the patients, undertook the statistical analyses and wrote the manuscript. All authors contributed to and have approved the final manuscript.

Ethics approval

All the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent to participate

All participants provided a written informed consent for the participation to the study.

Consent for publication

All participants received written information about the purpose of the study with the explanation that data will be analyzed in aggregate form and made available for publication and they provided written consent.

Availability of data and material

The data that support the findings of this study are available on request from MT. The data are not publicly available due to ethical and privacy restrictions.

Code availability

Not applicable.

1. INTRODUCTION

Social skills are severely impaired in patients with schizophrenia; among these, difficulties in interpersonal communication have been are considered a core feature of the disorder [1-4]. In general, conversational skills are one of the most important contributors to the process of socialization, allowing people to establish and to maintain relationships with others [5]. Besides mere linguistic capacities, a fluid conversation requires additional shared specific communicative abilities, particularly tacit knowledge of the rules and of the organization of social interactions. Conversation analysis is the linguistic methodology specifically focusing on the investigation of the internal structure of conversation, through the identification of specific conversational patterns (e.g. turn-taking) [5].
In this context, conversation analysis may also be conceived of as an empirical tool to investigate the phenomenology of intersubjectivity, particularly the pathways through which intersubjectivity progressively evolves into communicative interactions [6]. Interestingly, from the first months of life newborns are engaged in "proto-conversation" [7, 8], i.e. in pre-verbal dialogues with their caregivers, constituted by an immediate and mutual exchange of gestures and expressions punctuated by a precise rhythmicity, intensity and form.
Anomalies of intersubjectivity represent a cornerstone of schizophrenia psychopathology [9-14], intimately linked to subtle qualitative anomalies of *the sense of the self* (i.e. Self disturbances, SDs). SDs are subjective phenotypes of schizophrenia vulnerability [15, 16] and include a subset of anomalous experiences such as unstable or attenuated sense of self-presence, lack of basic sense of self-coincidence, blurred self-demarcation, disturbance in the tacit fluidity of the field of awareness, hyper-reflexivity and difficulty in grasping familiar meanings [15, 16]. In schizophrenia patients, a "fragile" sense of the self is intertwined with a failure of intersubjectivity, which in turn entails the incapacity to intuitively grasp the unwritten rules in social interactions, including the impairment of pre-reflective communicative patterns [17, 18]. From this perspective, conversation analysis may shed light on specific dialogical anomalies in schizophrenia spectrum disorders, which play a role in affecting social functioning.

However, very few studies have performed conversation analyses in a clinical population of schizophrenia patients. Exploring various communicative skills, Colle et al. [19] compared schizophrenia patients and healthy control persons through the ABaCo scale (Assessment Battery of Communication) [20]. One of the capacities tested was participants' ability to maintain an adequate turn-taking during the interview, such as the capacity to leave the interlocutor the opportunity to speak during their turn, to fill the pauses left by the interlocutor without overlapping with the other and to adopt cohesive lexical forms. Patients scored significantly worse in all these tasks as compared to control persons.
Interestingly, in recent years new technological tools in experimental linguistics have been developed allowing have allowed precise and quantitative analyses of different aspects of language, particularly in the field of phonetics. These methods have also been applied to the study of language in different psychopathological conditions, including schizophrenia spectrum disorders [21-24]. In A recent study of automated conversation analysis in

schizophrenia patients [25], found significant correlations were found between negative symptoms and specific conversational data, particularly mutual silence, response time, reduced turn duration and speaking percentage.
Sichlinger et al. [26] conducted a conversation analysis study in subjects at high risk of psychosis. Particularly, they focused on the duration of the interviewer's questions, the participant's answers and the “between-turn pauses” (BTP, i.e. the pauses preceding the participant's answers). The duration of BTP, considered as a fundamental element of turn-taking, was associated with the severity of positive symptoms, while no associations were found with negative symptoms.
Altogether, the available literature is controversial and affected by different limitations. For example, in the study of Colle et al. [19], “turn-taking” assessment focused only on certain features and scores were assigned on the basis of the examiner’s subjective evaluation. In the study by Tahir et al. [25], the aim was to find an automated and objective method for the measurement of negative symptoms, thus excluding from the analysis other psychopathological dimensions (e.g. positive and disorganization symptoms) and social functioning. Furthermore, to the best of our knowledge, no study investigated a possible correlation between SDs and language anomalies (including conversational patterns) in schizophrenia confirming, as Sass and Pienkos pointed out, that *“the experience of language is a neglected topic (...) in classical and contemporary phenomenological psychopathology”* [27].

Therefore, the present study is aimed at investigating the conversational patterns of dialogues in schizophrenia patients through an innovative method of semi-automatic analysis, in order to assess: 1) their possible association with symptom dimensions, formal thought and language disorders and 2) SDs, as well as 3) a relationship between specific dialogical features and social functioning.

2. MATERIAL AND METHODS

2.1 Participants

All participants were recruited from the Psychiatric Unit of the University Hospital of Parma from January 2018 to December 2019.
Patients were included in the study if 1) they were aged between 18 and 65 years; 2) they received a diagnosis of schizophrenia, following DSM-5 criteria [28]; 3) they provided a written informed consent to study participation was obtained; and 4) they reached the resolution of the acute phase of illness was reached (defined as the achievement of a clinical stabilization phase with initial symptom response and reduced psychotic symptom severity). The latter was described refers to a reduction in psychoticism dimension (hallucinations and delusions) to a low to mild symptom intensity level [29]. Patients were excluded if they were affected by 1) a current mental disorder related to a general medical condition or to drug or alcohol abuse or dependence; and 2) a cognitive disorder (Mini-Mental State Examination score lower than 25) [30], which could impair the compliance with testing procedures.

2.2 Instruments and procedures

The Structured Clinical Interview for DSM-5 (SCID-5-CV) [31] confirmed the diagnosis of schizophrenia. We adopted the three-factor model of the Positive and Negative Syndrome Scale (PANSS) [32] was adopted to assess the severity of psychotic symptoms. In addition to PANSS positive, negative, and general psychopathology scores, we sought to evaluate the disorganization dimension. The PANSS disorganization score was computed by summing the items of conceptual disorganization (P2), difficulty in abstraction (N5), stereotyped thinking (N7), mannerism (G5), disorientation (G10), poor attention (G11), lack of judgment and insight (G12), and disturbance of volition (G13) [33].
The Clinical Language Disorder Rating Scale (CLANG) [34] and the Scale for the Assessment of Thought, Language and Communication (TLC) [35], previously adopted with Italian speaking participants [36] were used to assessed formal thought and language disorders. We used these two scales were used to evaluate language and formal thought disorders, since conversational patterns may be affected by them. The CLANG scale consists of 17 items, rated on a Likert scale from 0 (normal) to 3 (severe). Following Chen [34], the CLANG is then divided into the Syntax, the Semantic and the Production subscales. The TLC scale consists of 18 items, half rated from 0 (absent) to 4 (extreme) and the other half from 0 (absent) to 3 (severe). As proposed by Andreasen [35], the TLC scale is divided into 2 subscales, namely Disconnected Speech and Underproductivity.
We adopted the Examination of Anomalous Self Experience Scale (EASE) [37], a 57-item semi-structured interview, was used to evaluate SDs. The scale was administered by BDD, trained in its use by one of the authors of the EASE scale (JP). The EASE explores five domains are explored (Domain 1: Cognition and stream of consciousness; Domain 2: Self-awareness and presence; Domain 3: Bodily experiences; Domain 4: Demarcation/transitivism; Domain 5: Existential reorientation).
The Social and Occupational Functioning Assessment Scale (SOFAS) [38] was adopted for the evaluation of the level of functioning.

2.2.1 Treatment

All patients were treated with antipsychotics received antipsychotic treatment. Patients who had moderate to severe depressive symptoms also received a serotoninergic medication.

2.3 Conversation analysis

The participants of the study underwent semi-structured interviews, aimed at eliciting a spontaneous speech of the duration of 15-30 minutes. They were invited to answer to general questions (examples: “what are your interests, your passions?”, “what do you do in your free time?”); then to listen to and comment a short piece of fiction (the Sufi story “The six blind people and the elephant”). Finally, they were invited to describe and talk about two reproductions of paintings (“Paris par la fenêtre” by Chagall and “Etagen” by Kandinsky). The interviews were conducted by A trained experimenter and interviewer (VL) conducted the interviews in a quiet and noiseless environment. We designed the

present protocol was designed referring to those adopted in previous studies [39, 40]. Recordings were made using a one-channel audio-recorder, converted to .wav files, and annotated using the Praat software [41], widely used in experimental phonetics. We selected the first 5 minutes of each recording were selected, according to previous studies [22, 23] of phonetic analysis in schizophrenia spectrum disorders.
While conversational analysis is traditionally concerned with fine-grained qualitative analyses of interactional phenomena, in this study we opted for the exploration of a subset of conversational metrics, which can be easily quantified and correlated with the study variables. Each recorded track was annotated via script into interpausal units, defined as stretches of speech separated by silent periods of at least 200ms. The annotated files were used to generate a figure representing turn alternation across the duration of the dialogue (see Figure 1 for an example). In this figure, each horizontal bar corresponds to an interpausal unit uttered by one of the two speakers involved in the dialogue (speakers are color-coded; red for the interviewer and black for the patient). Time unfolds from top to bottom (minutes) and from left to right (seconds) so that the conversation can be followed as on a written page in a left to right writing system. Silence is represented by blank areas (e.g. around t = 0:50) and overlapping speech by overlapping lines (e.g. around t = 3:30).

<Figure 1>

Additionally, we calculated the following conversational variables:

- Participant occupation floor: total conversation time occupied by the participant;
- Interviewer occupation floor: total conversation time occupied by the interviewer;
- Overlap: total conversation time occupied simultaneously by both interlocutors;
- Mutual silence: total conversation time occupied by the simultaneous silence of both interlocutors;
- Average turn/silence duration for the participant: average duration of the participant's speaking and silence turns.

2.4 Statistical analysis

After evaluating the normal distribution of the variables, we used Pearson's and Spearman's correlations were used where appropriate, in order to investigate the relationship between conversational data, socio-demographic features, schizophrenia symptom dimensions (PANSS total, positive, negative, disorganization scores), formal thought and language disorders (CLANG total score, CLANG Syntax subscale, CLANG Semantic subscale, CLANG Production subscale, TLC total score, TLC Disconnected speech subscale and TLC Underproductivity subscale), SDs (EASE total score, EASE Domain 1, EASE Domain 2, EASE Domain 3, EASE Domain 4, EASE Domain 5 scores) and social functioning (SOFAS score). Significant correlations were subsequently entered in a linear regression model (Enter method) to evaluate the effect of conversational features and psychopathological dimensions (independent variables) on SOFAS score (dependent variable).

We subsequently used a Benjamini Hochberg FDR correction over p values in order to perform multiple comparisons.
The false discovery rate method of Benjamini and Hochberg ("BH" procedure) controls the expected proportion of false discoveries amongst the rejected hypotheses. The false discovery rate is a less stringent condition than the family-wise error rate, so this method is more powerful than others like Bonferroni.
We used the statistical software package R [42, 43] for all the statistical analyses.

3. RESULTS

3.1 Participants

35 patients, 28 males (80%) and 7 females (20%) were enrolled into the study. Table 1 reports the historical, sociodemographic, clinical features and conversational data are reported in Table 1. Of them, 27 (77%) also completed the EASE.

<Table 1>

3.2 Conversational data and socio-demographic features

The patterns of correlation among the study variables in the overall sample are reported in Table 2 Figure 2. No associations were found between conversational variables and age, education, biological sex, status of employment, illness duration and treatment.

<Table Figure 2>

3.3 Conversational data and schizophrenia symptom dimensions

We did not find any No associations were found between conversational variables and PANSS positive or disorganization symptoms. An inverse correlation was found between participant occupation floor time and PANSS negative symptoms score ($r = -0.46$, p value < 0.01), whereas interviewer occupation floor time was positively associated with PANSS negative symptoms ($r = 0.41$, p value < 0.05). Participant occupation floor time was negatively associated with the PANSS total score ($r = -0.34$, p value < 0.05). Average turn duration was negatively associated with PANSS negative score (r rho = - 0.35, p value < 0.05), while average pause duration was positively associated with PANSS negative score (rho = 0.35, p value < 0.05).

3.4 Conversational data and language and thought disorders

Participant occupation floor time, interviewer occupation floor time, periods of mutual silence, average turn duration and average pause duration were associated with the CLANG Production subscale (r rho = -0.39, p value < 0.05;r rho = 0.37, p value < 0.05; r rho = 0.42, p value < 0.05 ; r rho = -0.38, p value < 0.05; r rho = 0.35, p value < 0.05). We also found significant correlations were also found between participant occupation floor,

interviewer occupation floor, mutual silence, average turn duration, average pause duration and TLC Underproductivity subscale (r rho = -0.57, p value < 0.01; r rho = 0.576, p value < 0.01;r rho = 0.36, p value < 0.05; r rho = -0.4539, p value < 0.05; rrho = 0.4754, p value < 0.01).

3.5 Conversational data and self disturbances

Conversation variables were not associated with EASE total score. A negative correlation was found between average pause duration and EASE Domain 5 (Existential reorientation) (r rho = -0.43, p value < 0.05). A significant positive correlation between Average pause duration and the item 1.8-Spazialization of thought of EASE Domain 1 (Cognition and stream of consciousness) were positively correlated (rho = 0.42, p value < 0.05).

3.5 Conversational data and social functioning

Participant occupation floor time was positively associated with SOFAS score (r = 0.38, p value < 0.05).
Linear regression showed that the level of social functioning (SOFAS score, dependent variable) was negatively related to the severity of positive and negative symptoms (Table 3 2).

<Table 3 2>

3.6 FDR correction

After a Benjamini Hochberg FDR correction, the following correlations between: participant occupation floor time and PANSS negative symptoms score (r = -0.46, p value < 0.05); mutual silence and CLANG Production subscale (rho = 0.48, p value < 0.05); participant occupation floor and TLC underproductivity subscale (rho = -0.51, p value < 0.05); interviewer occupation floor and TLC underproductivity subscale (r = 0.58, p value < 0.01) were still significant.

4. DISCUSSION

The present study was aimed at assessing the feasibility of the exploration of the conversational analysis metrics for schizophrenia psychopathology. We investigated the relation between everyday conversation parameters and main symptom dimensions, formal thought and language disorders, as well as abnormal subjective experiences in a clinical sample of schizophrenia patients. The second objective was to assess a relationship between dialogical aspects and global functioning.
The results of the present study suggest that conversational variables in schizophrenia patients are associated with both symptom dimensions and anomalous Self experiences.

With specific regard to symptom dimensions, our results, in line with Tahir and colleagues' study [25], overall show an association between conversational patterns and negative symptoms. This correlation remained significant even after correcting for multiple comparisons. On the one hand conversational data may represent an objective measure of the negative dimension, on the other the severity of negative symptoms may affect the patient's participation in the conversation. Regardless of the direction of this relationship, the use of semi-automatic methods of conversational analysis can be viewed as a reliable and precise tool to quantify those negative symptoms that refer to communicative abilities. This is a particularly important finding as negative symptoms represent a core feature of schizophrenia psychopathology which is challenging to grasp with clinical tools and to treat with pharmacological treatments [44]. Interestingly, a recent study [45] suggested that non-verbal social behavior (e.g. nodding, smiling and gesturing) in schizophrenia patients is inversely correlated with negative symptom severity. Taken together, in schizophrenia the disruption of interactional non-verbal prosocial behaviors, including abnormal conversational patterns, appears to be linked to the negative dimension.

By contrast, we failed to find any association between conversational variables and either disorganization or positive symptoms. Consequently, abnormalities in conversational data cannot be interpreted as a reflection of the severity of "reality distortion" symptoms, which actually show a lower diagnostic stability and predictive validity in schizophrenia [46-48]. It should be noted however, that patients were enrolled in the study after the achievement of a clinical stabilization phase in order to be eligible for evaluation and were all taking psychopharmacological treatment, with an overall reduction of positive symptoms at the time of the assessment.
As to thought and language disorders, as expected, present study suggests an association between conversation metrics and CLANG and TLC subscales referring to language productivity impairment, which was confirmed after correction for multiple comparisons.

For SDs, we found a negative association between average pause duration and "existential reorientation" (EASE Domain 5). The "existential reorientation" domain refers to a fundamental rearrangement with respect to patients' general metaphysical worldview and/or hierarchy of values, projects and interests [15]. We speculate that an impairment of non-verbal prosocial behaviors may affect the possibility for patients to "re-orientate" and adjust with psychotic experiences.
Pause duration was also positively related to the item 1.8-"spatialization of thought". In general, EASE Domain 1 concerns disturbances of the so-called "stream of consciousness"[15, 37]. Specifically, "spatialization of thought" refers to the attitude of the patient to experience his own mental processes in "object-like" terms [37], e.g. located in a precise part of the head or brain. The results of our study, although preliminary and partial, seem to suggest that the fluidity of communicative interaction and of the spatialization of thought are linked, affecting the natural and tacit interaction with the others, possibly on the basis of this particular circumscribed capacity covered by item 1.8.

Finally, with regard to global functioning, we found an association between participant occupation floor time and the SOFAS score. However, the result seems to be mainly due

to the impact of the negative symptomatology on global functioning, as confirmed by the regression analysis.

Conversation metrics may represent a promising tool to objectively translate schizophrenia symptom dimensions and language productivity. In this study, we focused on those structural measures of conversation activity which are independent from the content and easy to quantify, such as the quantity, duration and distribution of interpausal units and silences. Future research will explore the merit of other metrics commonly employed in conversation analyses, such as the so-called “floor transfer onset”, which measures the temporal distance between turns from different speakers [49]. Moreover, we suggest that this methodology may empirically explore and operationalize the peculiar feeling of unease or bizarreness experienced by the psychiatrist while encountering a person with schizophrenia, often referred to as “praecox feeling” [50, 51], which in effect, in its original description, was intimately linked to non-verbal prosocial interactional behaviors (e.g. body posture, facial expression, tone of voice, motor behavior) [52].

The main strength of the present study is that, unlike previous studies [25], the recordings were not focused on clinical investigations but were dealing with everyday experiences instead, thus helping the patients to better feel at ease and making the experimental condition as similar as possible to real-life encounters.

The main limitation of our study concerns its cross-sectional design. In fact, the complex relationship between conversational patterns and symptom dimensions might vary over time. Moreover, these results should be viewed with the caveat of the small sample size. In this regard, not all the associations were confirmed after Benjamini-Hochberg FDR correction for multiple comparisons. Therefore, the present results should be interpreted cautiously and larger longitudinal studies are needed to confirm our data. Another limitation is the lack of a group of healthy control persons. Finally, we analyzed only the first 5 minutes of each dialogue, due to the low quality of the one-channel recordings and the necessity to manually create the text grids for the subsequent analysis by Praat [41]. For the same reason, the analysis was limited to few dialogical aspects. It should be noted, however, that two-channel microphone recordings make the experimental condition less ecologically valid and probably more difficult for the patients to accept because of the use of a microphone (preferentially a headset mounted one), which may cause a selection bias.
Future research should analyze conversations beyond the easily quantifiable metrics employed in this study, in order to better understand the communicative deficit displayed by these patients. A fine-grained analysis of both interactions and speech content would permit the conduction of more in-depth linguistic investigations. Moreover, the evaluation of prosodic features could help to understand the role played by prosody in organizing turn-taking in this population [53]. Future studies should also evaluate the effect of psychosocial interventions in relation to conversational aspects on outcome. Finally, a comparison with healthy controls could help to detect possible conversational patterns specific to schizophrenia.

5. CONCLUSIONS

The results of the present study suggest that in schizophrenia patients, conversational patterns are mainly associated with the negative symptom dimension. Moreover, our findings evoke a relationship between the natural fluidity of conversation and of the natural thoughts unraveling.

TABLES

Table 1: Socio-demographic, clinical and conversational features in the study sample

Variable	Patients (n =35)	
	Mean ± SD	
Age	35.9±11.2	
Education years	12.5±9.9	
	n	%
Gender		
Male	28 (80%)	
Marital status		
Single	35 (100%)	
Working status		
Employed/student	12 (34.3%)	
Unemployed	23 (65.7%)	
	Mean ± SD	
Antipsychotic therapy		
Total Chlorpromazine-equivalent dose	415.5±241.8 mg/d	
	n	%
Oral treatment	31 (89%)	
LAI treatment	8 (23%)	
1st generation AP	1 (3%)	
2nd generation AP	34 (97%)	
	Mean ± SD	
PANSS total score	76.9±16.9	
Positive scale	15.4±5.7	
Negative scale	21.6±5.1	
General psychopathology scale	39.9±9.9	
Disorganization scale	6±2.4	
CLANG total score	10.9±7.3	
Syntax scale	1.7±2.7	
Semantic scale	3.4±2.8	
Production scale	2.3±2.7	
TLC total score	12.2±9.2	
Disconnected speech scale	0.7±0.8	
Underproductivity scale	0.6±1	
EASE total score	16.8±5 (n 27)	
EASE 1 Cognition and stream of consciousness	5.8±2.2 (n 27)	
EASE 2 Self-awareness and presence	6.6±2.3 (n 27)	
EASE 3 Bodily Experiences	1.5±1.6 (n 27)	
EASE 4 Demarcation/Transitivism	0.4±0.8 (n 27)	
EASE 5 Existential reorientation	2.3±1.7 (n 27)	
SOFAS total score	50.3±12.7	
Conversational features		
Participant occupation floor (sec)	164.7±43.5	
Interviewer occupation floor (sec)	64.5±28.6	
Overlap (sec)	14.7±27.5	
Mutual Silence (sec)	56.1±26.8	
Average turn duration (sec)	2.7±1.4	
Average silence duration (sec)	1.7±0.7	

Table 2: Predictor of SOFAS score (dependent variable)

		β	t	p
Step 1	Participant floor occupation	0.38	2.34	<0.05
Step 2	Participant floor occupation	0.17	1.09	0.29
	PANSS positive tot	-0.33	-2.29	<0.05
	PANSS negative tot	-0.34	-2.08	<0.05

FIGURES

Figure 1: Graphic representation of a dialogic turn alternation
Each horizontal bar corresponds to an interpausal unit uttered by one of the two speakers involved in the dialogue (speakers are color-coded; red for the interviewer and black for the patient). Time unfolds from top to bottom (minutes) and from left to right (seconds) so that the conversation can be followed as on a written page in a left to right writing system. Silence is represented by blank areas (e.g. around t = 0:50) and overlapping speech by overlapping lines (e.g. around t = 3:30).

Figure 2: Correlations among conversation variables, symptom dimensions, language and thought disorders, self disturbances and global functioning in the study sample
The figure is a graphic representation of a correlation matrix among the study variables. The colors of the spots represent the direction of the correlation (blu for positive, red for negative) and the dimension of the correlation magnitude (the biggest the spot, the highest the correlation coefficient)

REFERENCES

1. Bleuler E (2014) Dementia praecox oder Gruppe der Schizophrenien. Neuausgabe, Psychosozialverlag, Gießen.

2. Couture SM, Penn DL, Roberts DL (2006) The functional significance of social cognition in schizophrenia: a review. Schizophr Bull 32(1):44-63. https://doi.org/10.1093/schbul/sbl029.

3. Crow TJ (2000) Schizophrenia as the price that Homo sapiens pays for language: a resolution of the central paradox in the origin of the species. Brain Res Brain Res Rev 31:118-129. https://doi.org/10.1016/s0165-0173(99)00029-6

4. Kraepelin E (1899) Psychiatrie. Ein Lehrbuch für Studierende und Ärzte (6. Auflage). Johann Ambrosius Barth, Leipzig.

5. Drew P (2005) Conversation analysis. In: Fitch KL, Sanders RE (ed) Handbook of language and social interaction. Lawrence Erlbaum, Malwah, NJ, pp 71-102.

6. Schegloff EA (1992) Repair after next turn: the last structurally provided defence on intersubjectivity in conversation. Am J Sociol 97(5):1295-1345. https://doi.org/10.1086/229903.

7. Beebe B, Sorter D, Rustin J, Knoblauch S (2003) A comparison of Meltzoff, Trevarthen and Stern. Psychoanal Dialogues 13(6): 777-804. https://doi.org/10.1080/10481881309348768.

8. Trevarthen C (1994) The self born in intersubjectivity: the psychology of an infant communicating. In: Neisser U (ed) The Perceived Self: Ecological and Interpersonal Sources of Self Knowledge. Cambridge: Cambridge University Press, pp 121-173.

9.Blankenburg W (1971) Der Verlust der Natürlichen Selbstverständlichkeit. Ein Beitrag zur Psychopathologie symptomarmer Schizophrenien. Ferdinand Enkel Verlag, Stuttgart.

10. Kimura B (1992) Ecrits de psychopathologie phénomenologique. J. Bouderlique, Trans. Presses Universitaires de France, Paris.

11. Kimura B (1995) Zwischen Mensch und Mensch. E. Weinmayr, Trans. Wissenschaftliche Buchgesellschaft, Darmstadt.

12. Minkowski E (1927) La schizophrénie: Psychopathologie des schizoïdes et des schizophrènes. Payot, Paris.

13. Stanghellini G, Ballerini M, Mancini M (2017) Other Persons: On the Phenomenology of Interpersonal Experience in Schizophrenia (Ancillary Article to EAWE Domain 3). Psychopathology. 50:75-82. https://doi.org/ doi: 10.1159/000456037.

14. Van Duppen Z (2016) Schizophrenia: a disorder of intersubjectivity. A phenomenological analysis. Dissertation, University of Heidelberg.

15. Parnas J, Handest P (2003) Phenomenology of anomalous self-experience in early schizophrenia. Compr Psychiatry 44(2):121-134. https://doi.org/10.1053/comp.2003.50017.

16. Sass LA, Parnas J (2003) Schizophrenia, consciousness and the self. Schizophr Bull 29(3):427-444. https://doi.org/10.1093/oxfordjournals.schbul.a007017.

17. Pienkos E, Sass L (2017) Language: On the Phenomenology of Linguistic Experience in Schizophrenia (Ancillary Article to EAWE Domain 4). Psychopathology 50:83-89. https://doi.org/10.1159/000455195.

18. Sass L, Pienkos E, Skodlar B, Stanghellini G, Fuchs T, Parnas J, Jones N (2017) EAWE: Examination of Anomalous World Experience. Psychopathology 50:10-54. https://doi.org/10.1159/000454928.

19. Colle L, Angeleri R, Vallana M, Sacco K, Bara BG, Bosco FM (2013) Understanding the communicative impairments in schizophrenia: a preliminary study. J Commun Disord 46:294-308. https://doi.org/10.1016/j.jcomdis.2013.01.003.

20. Sacco K, Angeleri R, Bosco FM, Colle L, Davide M, Bara BG (2008) Assessment battery for communication-ABaCo: a new instrument for the evaluation of pragmatic abilities. Cogn Sci 9:111-157. https://doi.org/10.17791/jcs.2008.9.2.111.

21. Alpert M, Rosenberg SD, Pouget ER, Shaw RJ (2000) Prosody and lexical accuracy in flat affect schizophrenia. Psychiatry Res 97(2-3):107-118. https://doi.org/10.1016/s0165-1781(00)00231-6.

22. Cannizzaro MS, Cohen H, Rappard F, Snyder PJ (2005) Bradyphrenia and bradykinesia both contribute to altered speech in schizophrenia: a quantitative acoustic study. Cog Behav Neurol 18(4):206-210. https://doi.org/10.1097/01.wnn.0000185278.21352.e5.

23. Compton MT, Lunden A, Cleary SD, Pauselli L, Alolayan Y, Halpern B, Broussard B, Crisafio A, Capulong L, Balducci PM, Bernardini F, Covington MA (2018) The aprosody of schizophrenia: computationally derived acoustic phonetic underpinnings of monotone speech. Schizophr Res 197:392-399. https://doi.org/10.1016/j.schres.2018.01.007.

24. Martínez-Sánchez F, Muela-Martínez JA, Cortés-Soto P, García Meilán JJ, Vera Ferrándiz JA, Egea Caparrós A, Pujante Valverde IM (2015) Can the acoustic analysis of expressive prosody discriminate schizophrenia? Span J Psychol 18(e86):1-9. https://doi.org/10.1017/sjp.2015.85.

25. Tahir Y, Yang Z, Chakraborty D, Thalmann N, Thalmann D, Maniam Y, Binte Abdul Rashid NA, Tan BL, Lee Chee Keong J, Dauwels J (2019) Non-verbal speech cues as

objective measures for negative symptoms in patients with schizophrenia. PloS one 14(4): e0214314. https://doi.org/10.1371/journal.pone.0214314.

26. Sichlinger L, Cibelli E, Goldrick M, Mittal VA (2019) Clinical correlates of aberrant conversational turn-taking in youth at clinical high-risk for psychosis. Schizophr Res 204:419-420. https://doi.org/10.1016/j.schres.2018.08.009.

27. Sass L, Pienkos E (2013) Beyond words: linguistic experience in melancholia, mania and schizophrenia. Phenom Cogn Sci 14:475-495. https://doi.org/10.1007/s11097-013-9340-0.

28. American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders, DSM-5. American Psychiatric Association Publishing, Washington DC.

29. Andreasen NC, Carpenter WT Jr, Kane JM, Lasser RA, Marder SR, Weinberger DR (2005) Remission in schizophrenia: proposed criteria and rationale for consensus. Am J Psychiatry 162(3):441-9. https://doi.org/10.1176/appi.ajp.162.3.441.

30. Folstein MF, Folstein SE, McHugh PR (1975) Mini-mental state: a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 12(3):189-198. https://doi.org/10.1016/0022-3956(75)90026-6.

31. First MB, Williams JBW, Karg RS, Spitzer RL (2016) Structured Clinical Interview for DSM-5 Disorders, Clinician Version (SCID-5-CV). American Psychiatric Association Publishing, Washington DC.

32. Kay SR, Flszbeln A, Opler LA (1987) The Positive and Negative Syndrome Scale (PANSS) for Schizophrenia. Schizophr Bull 13(2):261-276. https://doi.org/10.1093/schbul/13.2.261.

33. van der Gaag M, Hoffman T, Remijsen M, Hijman R, de Haan L, van Meijel B, van Harten PN, Valmaggia L, de Hert M, Cuijpers A, Wiersma D (2006) The five-factor model of the Positive and Negative Syndrome Scale II: a ten-fold cross-validation of a revised model. Schizophr Res 85(1-3):280-7. https://doi.org/10.1016/j.schres.2006.03.021.

34. Chen EYH, Lam LCW, Kan CS, Chan CKY, Kwok CL, Nguyen DGH, Chen RYL (1996) Language disorganisation in schizophrenia: validation and assessment with a new clinical rating instrument. Hong Kong J. Psychiatry 6:4–13.

35. Andreasen N (1986) Scale for the assessment of thought, language and communication. Schizophr Bull 12(3):473-482. https://doi.org/10.1093/schbul/12.3.473.

36. Vita A, Dieci M, Giobbio GM, Caputo A, Ghiringhelli L, Comazzi M, Garbarini M, Mendini AP, Morganti C, Tenconi F, Cesana B, Invernizzi G (1995) Language and thought disorder in schizophrenia: brain morphological correlates. Schizophr Res 15(3):243-51. doi: 10.1016/0920-9964(94)00050-i. PMID: 7632621.

37. Parnas J, Møller P, Kircher T, Thalbitzer J, Jansson L, Handest P, Zahavi D (2005) EASE: Examination of Anomalous Self-Experience. Psychopathology 38(5):236–258. https://doi.org/10.1159/000088441.

38. Goldman HH, Skodol AE, Lave TR (1992) Revising axis V for DSM-IV: a review of measures of social functioning. Am J Psychiatry 149(9):1148-1156. https://doi.org/10.1176/ajp.149.9.1148.

39. Ceccherini-Nelli A, Crow TJ (2003) Disintegration of the components of language as the path to a revision of Bleuler's and Schneider's concepts of schizophrenia: Linguistic disturbances compared with first-rank symptoms in acute psychosis. Br J Psychiatry 182:233-240. https://doi.org/10.1192/bjp.182.3.233.

40. Ceccherini-Nelli A, Turpin-Crowther K, Crow TJ (2007) Schneider's first rank symptoms and continuous performance disturbance as indices of dysconnectivity of left- and right-hemispheric components of language in schizophrenia. Schizophr Res 90(1-3):203-213. https://doi.org/10.1016/j.schres.2006.09.017.

41. Boersma P, Weenink D (2018) Praat: doing phonetics by computer [Computer program]. (Version 6.0.39).

42. R Core Team (2019) R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/.

43. Wickham H (2017) Tidyverse: Easily Install and Load the 'Tidyverse'. R package version 1.2.1. https://CRAN.R-project.org/package=tidyverse

44. Murphy BP, Chung YC, Park TW, McGorry PD (2006) Pharmacological treatment of primary negative symptoms in schizophrenia: a systematic review. Schizophr Res 88(1):5-25. https://doi.org/10.1016/j.schres.2006.07.002.

45. Worswick E, Dimic S, Wildgrube C, Priebe S (2018) Negative symptoms and avoidance of social interaction: a study of non-verbal behaviour. Psychopathology 51(1):1-9. https://doi.org/10.1159/000484414.

46. Loch AA (2019) Schizophrenia, Not a Psychotic Disorder: Bleuler Revisited. Front Psychiatry 10:328. https://doi.org/10.3389/fpsyt.2019.00328.

47. Marchesi C, Affaticati A, Monici A, De Panfilis C, Ossola P, Ottoni R, Tonna M (2015) Decrease of functioning in remitted and non-remitted patients 16 years after a first-episode schizophrenia. J Nerv Ment Dis 203(6):406-411. https://doi.org/10.1097/NMD.0000000000000299.

48. Tonna M, Ossola P, Marchesi C, Bettini E, Lasalvia A, Bonetto C, Lenzi J, Rucci P, Iozzino L, Cellini M, Comacchio C, Cristofalo D, D'Agostino A, de Girolamo G, De Santi K, Ghigi D, Leuci E, Miceli M, Meneghelli A, Pileggi F, Scarone S, Santonastaso P, Torresani S, Tosato S, Veronese A, Fioritti A, Ruggeri M; GET UP Group (2019) Dimensional structure of first episode psychosis. Early Interv Psychiatry 13(6):1431-1438.

https://doi.org/10.1111/eip.12789.

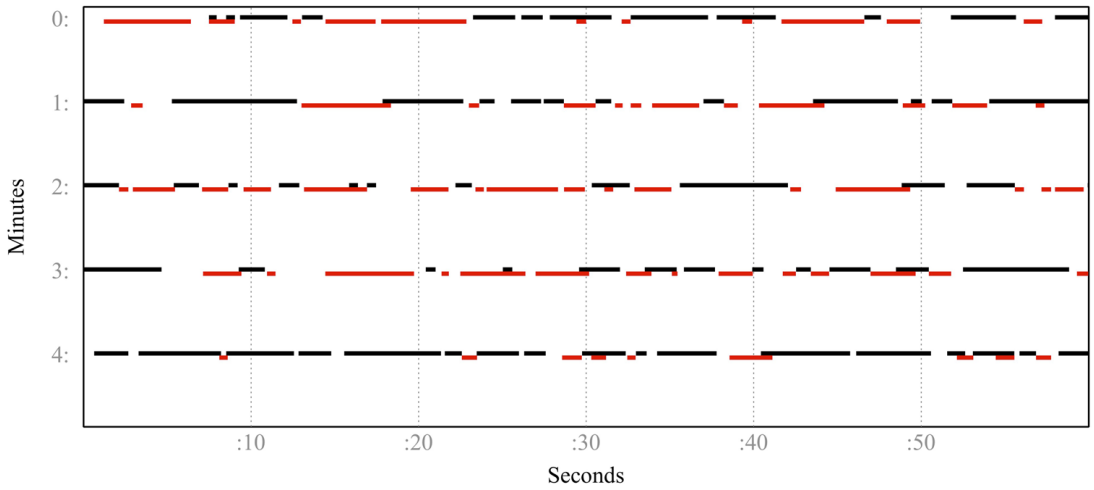
49. Levinson SC, Torreira F (2015) Timing in turn-taking and its implications for processing models of language. Front Psychol 6:731. https://doi.org/10.3389/fpsyg.2015.00731.

50. Gozé T, Moskalewicz M, Schwartz MA, Naudin J, Micoulaud-Franchi JA, Cermolacce M (2018) Is “praecox feeling” a phenomenological fossil? A preliminary study on diagnostic decision making in schizophrenia. Schizophr Res 204:413-414. https://doi.org/ doi: 10.1016/j.schres.2018.07.041.

51. Rümke HC (1958) Der klinische differenzierung innerhalb der gruppe der schizophrenien. Nervenarzt 29:49-53.

52. Gozé T, Moskalewicz M, Schwartz MA, Naudin J, Micoulaud-Franchi JA, Cermolacce M (2019) Reassessing “Praecox Feeling” in diagnostic decision making in schizophrenia. A critical review. Schizophr Bull 45(5):966-970. https://doi.org/10.1093/schbul/sby172.

53. Lucarini V, Grice M, Cangemi F, Zimmermann JT, Marchesi C, Vogeley K, Tonna M (2020) Speech Prosody as a Bridge Between Psychopathology and Linguistics: The Case of the Schizophrenia Spectrum. Front Psychiatry 11:531863. https://doi.org/10.3389/fpsyt.2020.531863.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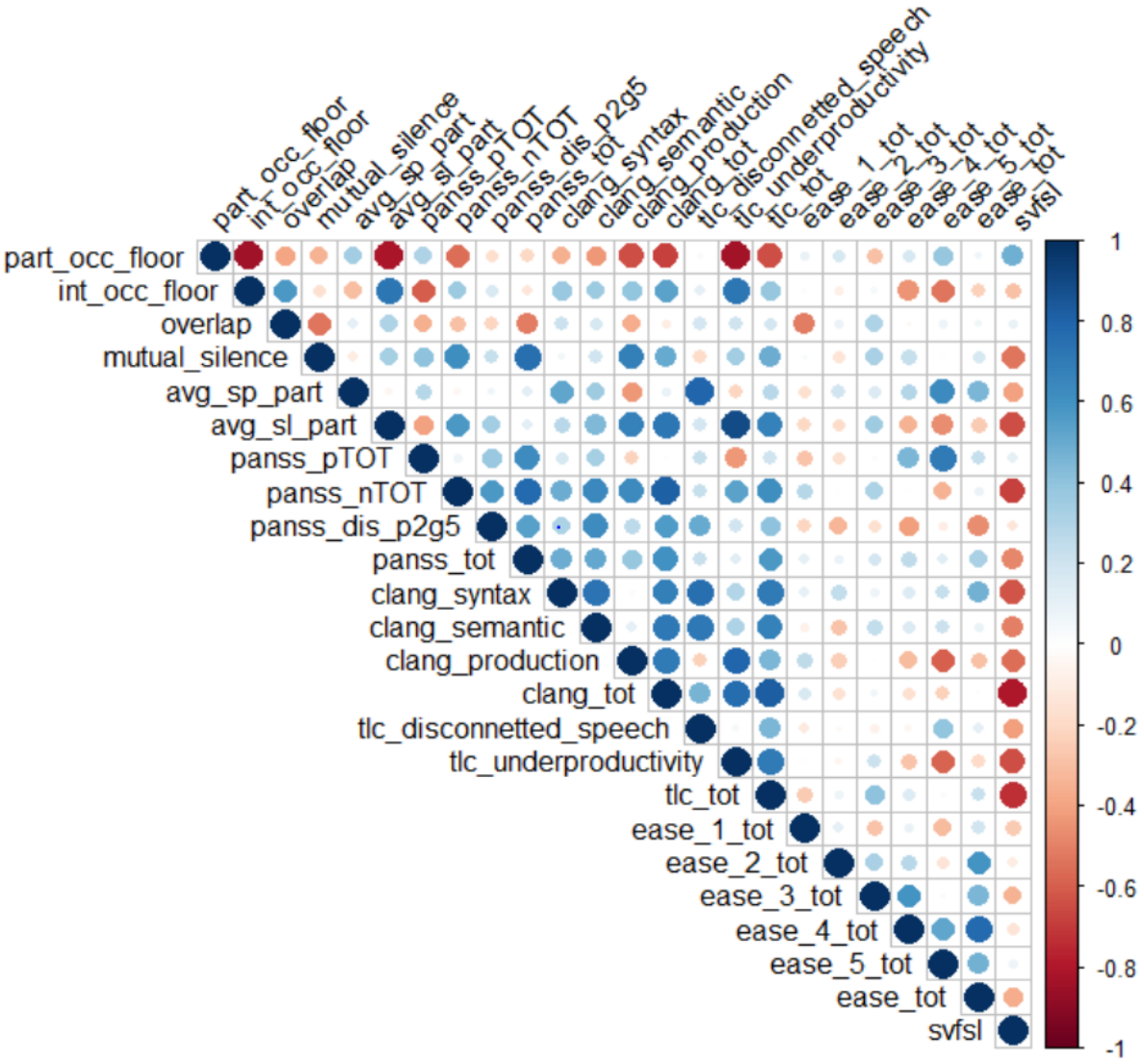
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