



Examination of formal thought disorder and its clinical correlates with the Turkish Version of the Thought and Language Disorder Scale (TALD-TR) in schizophrenia

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ABSTRACT

Background: Formal thought disorder (FTD) is considered to be a fundamental feature of schizophrenia. This study aims to analyze psychometric properties of the Turkish version of “Thought and Language Disorder Scale (TALD)” and investigate the relationship between FTD and various clinical characteristics in patients with schizophrenia.

Methods: TALD was adapted into Turkish and applied to a total of 149 participants of which 114 had DSM-5 psychiatric diagnoses (schizophrenia $N = 70$, mania $N = 20$, depression $N = 24$) and 35 were healthy controls. Positive and Negative Syndrome Scale (PANSS), Hamilton Depression Rating Scale, Young Mania Rating Scale, and Clinical Global Impression were administered to detect illness severity.

Results: The principal component analyses revealed that the Turkish version of TALD (TALD-TR) consisted of four factors including the Objective Positive (OP), Subjective Negative (SN), Objective Negative (ON) and Subjective Positive (SP) symptom dimensions which were in line with the original TALD factorial structure. It was concluded that TALD-TR shows strong construct validity and high interrater reliability. The correlation analyses with TALD-TR and PANSS showed that there are positive correlations between the TALD-TR total score and the PANSS total and subscale scores. Each diagnostic group showed the distinct pattern of FTD. The mania group exhibited the highest mean total score in the OP, whereas the schizophrenia group exhibited the highest mean total score in the ON factor. In the schizophrenia group, the severity of FTD correlated positively with duration of illness and negatively with age at onset of illness.

Conclusion: Adaptation of TALD into different languages seems to be possible, bringing in an international tool for research on FTD.

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1. Introduction

Formal thought disorder (FTD) is defined as division or fragmentation of logical, goal-oriented thinking process and comprises of language [1] and communication disorders [2]. Although these symptoms occur in many psychiatric diagnoses such as mania, depression, organic brain syndromes, FTD is considered mainly to be a core feature of schizophrenia since Bleuler [3]. Formal thought disorder can be subdivided into positive and negative dimensions as well as objective and subjective dimensions [1]. These symptom dimensions have predictive value for diagnosis, functioning and recovery [4–6], vary in different diagnostic groups [7,8] and are considered as a trait marker for

schizophrenia [9]. Although antipsychotic (AP) treatment has beneficial effects on acute positive FTD, negative and chronic FTD are usually resistant to treatment [1]. Moreover, the etiopathogenesis of FTD is not fully elucidated [10].

It is crucial to assess FTD comprehensively in a practical, operationalized way for etiopathogenesis, neurobiology, electrophysiology and imaging studies. Kircher and his colleagues [11] have developed the Thought and Language Disorder (TALD) scale which captures both positive/negative and objective/subjective FTD symptoms. The Thought and Language Disorder (TALD) scale consists of 30-items and is applied using a semi-structured interview which contains operationalized definitions of each symptom and symptom rating, along with directed questions and examples to separate objective and subjective FTD symptoms from each other. These properties separate TALD from other scales which specifically assess FTD (e.g.: Thought, Language, Communication Disorder (TLC) scale [12] or Thought and Language Index (TLI) [13]). In

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Table 1
Descriptive characteristics of the participants ($N = 149$)[#].

	Schizophrenia $N = 70$ (%)	Mania $N = 20$ (%)	Depression $N = 24$ (%)	Controls $N = 35$ (%)	χ^2	p
Gender					13.071*	0.004
Female	27 (39%)	10 (50%)	19 (79%)	21 (60%)		
Male	43 (61%)	10 (50%)	5 (21%)	14 (40%)		
Marital status					31.235**	<0.001
Married	11 (16%)	11 (55%)	16 (67%)	18 (51%)		
Single	53 (76%)	8 (40%)	5 (21%)	15 (43%)		
Separated/divorced	6 (8%)	1 (5%)	3 (12%)	2 (6%)		
Paid employment					36.131*	<0.001
Yes	28 (40%)	10 (50%)	11 (46%)	35 (100%)		
No	42 (60%)	10 (50%)	13 (54%)	0		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	F	p
Age	40.17 (10.76) ^{ab}	37.85 (12.21) ^{ab}	44.25 (14.20) ^a	34.83 (11.23) ^b	3.385***	0.020
Education (years)	11.64 (3.14) ^a	11.85 (3.05) ^a	10.17 (3.40) ^a	15.17 (3.73) ^b	13.055***	<0.001

SD: standard deviation.

^{ab}Different symbols indicate that the values in the row are significantly different from each other (corrected $p < 0.05$).[#] Chi-square test and ANOVA results.* $df = 3$.** $df = 6$.*** $df = (3145)$.

addition, TALD has been pointed as having an advantage for FTD symptom catching in various investigations including imaging studies, and studies including assessments of prodromal patients and their relatives [11]. This study aims to analyze the validity and reliability of the Turkish version of Thought and Language Disorder Scale (TALD-TR), and additionally examine the relationship between FTD and various sociodemographic and clinical characteristics in patients diagnosed with schizophrenia.

2. Material and methods

2.1. Study site and participants

This cross-sectional study was conducted at the Departments of Psychiatry of Hacettepe University Faculty of Medicine and Ankara Numune Training and Research Hospital. Patients who had a DSM-5 psychiatric diagnosis of schizophrenia ($n = 70$), mania ($n = 20$) or major depression ($n = 24$) and 35 healthy controls were included. All participants were aged between 18 and 65 years, had at least 5 years of formal education, had no neurological illnesses and were examined by two psychiatrists for diagnostic evaluation. Exclusion criteria included mental retardation, current substance use disorders, serious

medical disorders and inability to provide informed consent. Healthy controls were free of current and past psychiatric illnesses. The recruitment period was from April 2017 to April 2018. All patients gave written informed consent. The study was approved by the local ethics committee of Hacettepe University (Project number: GO 17/81).

2.2. Adaptation of Thought and Language Disorder (TALD) Scale into Turkish

Thought and Language Disorder Scale is a 30-item, semi-structured scale which contains four FTD factors; Objective Positive (OP), Subjective Negative (SN), Objective Negative (ON) and Subjective Positive (SP) [11]. The Cronbach's Alpha values for each factor are 0.92, 0.83, 0.58, and 0.58 respectively indicating high internal consistency.

The original English version of the TALD manual was obtained from Prof. Kircher of Philipps University, Marburg and the written translation permission was obtained. The scale and manual were translated into Turkish by two investigators (EM, EAY) and first translation text was reviewed by four other investigators (MKY, EB, AE, ŞCG, Department of Psychiatry, Hacettepe University). The reviewed Turkish translation was then applied to 15 individuals (10 were diagnosed with schizophrenia, 5 were healthy controls) in order to explore how the

Table 2
Clinical characteristics of the participants ($N = 149$)[#].

	Schizophrenia ($N = 70$) Median (IQR)	Mania ($N = 20$) Median (IQR)	Depression ($N = 24$) Median (IQR)	Controls ($N = 35$) Median (IQR)	χ^2	p
Duration of illness (years)	16 (17) ^a	14 (21) ^{ab}	4.5 (12) ^b	NA	11.556*	0.003
Age at illness onset	22 (10) ^a	23 (8) ^a	35 (26) ^b	NA	18.739*	<0.001
TALD-TR	20.5 (18) ^a	25 (9) ^a	8.5 (9) ^b	2 (2) ^c	89.950**	<0.001
PANSS	68 (31) ^a	67 (12) ^{ab}	48 (7) ^b	30 (1) ^c	87.961**	<0.001
HAMD	5.5 (4) ^a	5.5 (3) ^a	19.5 (8) ^b	0 (1) ^c	98.548**	<0.001
YMRS	6.5 (11) ^a	34 (12) ^b	0 (2) ^c	0 (0) ^c	94.101**	<0.001
CGI-illness severity	4 (2) ^a	5 (1) ^b	4 (2) ^{ab}	NA	8.919*	0.012

IQR: interquartile range.

TALD-TR: The Turkish version of Thought and Language Disorder scale.

PANSS: Positive and Negative Syndrome Scale.

YMRS: Young Mania Rating Scale, HAMD: Hamilton Depression Scale, CGI: Clinical Global Impression Scale-Severity.

NA: not applicable.

^{abc}Different symbols indicate that the values in the row are significantly different from each other.[#] Kruskal-Wallis test results.* $df = 2$.** $df = 3$.

translation worked. After this initial application, a second revision was undertaken by the whole group of investigators forming the final translation text. Factorial structure and distribution of scale items of the Turkish version of TALD (TALD-TR) are presented in the Results section.

To analyze interrater reliability of TALD-TR, interviews of randomly determined 20 patients diagnosed with schizophrenia were recorded on video. These 20 patients gave informed consent for video recording. The records were viewed and scored by two independent raters (EM and EAY). Intraclass correlation coefficient was 0.95, indicating a high interrater reliability.

2.3. Assessment of clinical characteristics

Sociodemographic and clinical characteristics of patients were recorded through a detailed form. Positive and Negative Syndrome Scale (PANSS) [14,15], Young Mania Rating Scale (YMRS) [16,17], Hamilton Depression Scale (HAMD) [18,19], Clinical Global Impression-Severity Scale (CGI) [20] were used to assess psychopathology and illness severity. Thought and Language Disorder Scale (TALD-TR) was administered to detect formal thought disorder symptoms. All clinical assessments were conducted during a one-hour interview and scored immediately thereafter. All assessment tools (except CGI for healthy controls) were applied to all participants by one rater (EM).

2.4. Statistical analyses

Statistical analyses were performed using the SPSS software version 22.0. The Chi-square test was used to compare categorical variables in different diagnostic groups. The continuous variables were investigated using histograms, probability plots and Kolmogorov-Smirnov test to detect whether the variables were normally distributed or not. Descriptive analyses were presented using means and standard deviations for normally distributed variables and medians and interquartile range (IQR) for the non-normally distributed variables. Mann Whitney *U* test was used to compare two independent groups when parametric test assumption was not met. One way ANOVA or Kruskal Wallis test was performed to compare more than two independent groups in terms of continuous variables where appropriate. Post-hoc tests (Tukey test for one way ANOVA and Bonferroni adjusted Mann Whitney test for Kruskal Wallis test) were applied when overall significance was observed. MANOVA was used to evaluate the differences of TALD-TR factor scores between diagnostic groups. When an overall significance was observed, post-hoc tests were performed using Bonferroni test.

Principal Component Analysis with varimax rotation was performed to detect factorial structure of TALD-TR. The full sample of patients and controls was used in the Principal Components Analysis. While investigating the associations between TALD factor scores and PANSS total and sub-scale scores and clinical characteristics, correlation coefficients and their significance were calculated using the Spearman test because the variables were not normally distributed. Cronbach alpha coefficient was calculated to show internal consistency. A *p* value of <0.05 was considered to show a statistically significant result.

3. Results

3.1. Descriptive and clinical characteristics

The sample consisted of 114 participants (schizophrenia *N* = 70, mania *N* = 20, major depression *N* = 24) and 35 healthy controls. In the whole sample, mean age was 39.3 ± 11.9 and 52% (*N* = 77) of the participants were females. No significant group differences in gender were found between diagnostic groups other than marital status, paid employment, age and years of education (Table 1).

Median duration of illness of patients was 14 years; median age at illness onset was 23. Depression group differed from other groups in duration of illness and age at illness onset (Table 2). In the Mania group,

Table 3
Frequency of drug groups according to diagnoses.

	Schizophrenia	Mania	Depression
	<i>N</i> = 70 (%)	<i>N</i> = 20 (%)	<i>N</i> = 24 (%)
Antipsychotic (AP)	67 (96)	18 (90)	4 (17)
1) Single typical antipsychotic	4 (6)	4 (20)	–
2) Single atypical antipsychotic	49 (70)	14 (70)	4 (17)
Clozapine	18	–	–
Non-clozapine AP	31	14 (70)	4 (17)
3) Combined antipsychotics	14 (20)	–	–
Clozapine augmentation	12	–	–
Antidepressant	27 (39)	2 (10)	14 (58)
Mood stabilizer	2 (3)	16 (80)	2 (8)
Benzodiazepine	9 (13)	4 (20)	3 (13)

the median duration of index manic episode was 4 weeks (IQR = 6.38) and in the Depression group the median duration of index depressive episode was 32 weeks (IQR = 38). In the Mania group, 3 of the patients were diagnosed with bipolar disorder during the current episode and the remaining 17 patients had a chronic diagnosis of bipolar disorder. Detailed drug information of the participants is provided at Table 3. Clinical characteristics of each group are presented at Table 2.

3.2. Frequencies of TALD-TR items

In the whole sample, the most common FTD was *Rumination* (46.3%); *Thought interference* (45%) and *Derailment* (38.3%) followed respectively. *Verbigeration* (4%) and *Echolalia* (0.7%) were rarely detected. Because of their infrequency these two items were excluded from the factor analysis (Table 4). In the schizophrenia group, *Poverty of content of speech* (64.3%) occurred most frequently, followed by *Poverty of speech* (62.9%) and *Derailment* (54.3%). Majority of patients (*N* = 58, 82.9%) in the schizophrenia group had mild or higher severity of FTD. Most frequent items observed in the healthy control group were two

Table 4
Frequencies of TALD-TR items (*N* = 149).

	<i>N</i>	%
Rumination	69	46.3
Thought interference	67	45.0
Derailment	57	38.3
Restricted thinking	52	34.9
Poverty of speech	52	34.9
Circumstantiality	51	34.2
Slowed thinking	48	32.2
Tangentiality	47	31.5
Poverty of content of speech	47	31.5
Perseveration	46	30.9
Poverty of thought	45	30.2
Expressive speech dysfunction	45	30.2
Concretism	43	28.9
Crosstalk	41	27.5
Pressured speech	41	27.5
Logorrhoea	38	25.5
Dissociation of thinking	35	23.5
Pressure/rush of thought	33	22.1
Blocking	32	21.5
Receptive speech dysfunction	29	19.5
Dysfunction of thought initiative and intentionality	27	18.1
Inhibited thinking	26	17.4
Rupture of thought	20	13.4
Phonemic paraphasia	12	8.1
Clanging	12	8.1
Manneristic speech	11	7.4
Semantic paraphasia	11	7.4
Neologisms	10	6.7
Verbigeration ^a	6	4.0
Echolalia ^a	1	0.7

^a These two items were not included into the factor analysis because of their low prevalence (<5%).

Table 5
Factorial structure of TALD-TR.

Factor	Eigenvalue	Explained variance	Cumulative variance	Items	Factor loadings	Cronbach's alpha
I. Objective positive	6.988	24.957	24.957	Derailment	0.90	0.91
				Logorrhoea	0.89	
				Circumstantiality	0.88	
				Tangentiality	0.88	
				Dissociation of thinking	0.81	
				Pressured speech	0.79	
				Perseveration	0.68	
				Restricted thinking	0.58	
				Manneristic speech	0.57	
				Clanging	0.52	
				Neologisms	0.44	
				Crosstalk	0.41	
				II. Subjective negative	4.568	
Expressive speech dysfunction	0.72					
Blocking	0.70					
Inhibited thinking	0.68					
Receptive speech dysfunction	0.62					
Dysfunction of thought initiative and intentionality	0.48					
Rumination	0.44					
Poverty of speech	0.81	0.76				
Slowed thinking	0.73					
Poverty of content of speech	0.71					
Concretism	0.60					
IV. Subjective positive	1.526	5.451	54.650	Rupture of thought	0.47	0.53
				Thought interference	−0.48	
				Pressure/rush of thought	−0.46	

subjective FTD symptoms: *Thought interference* (28.6%) and *Rumination* (20%). Only 8.5% of the healthy control group ($N = 3$) had mild FTD.

3.3. Factorial structure of TALD-TR and internal consistency

A principal component analysis with varimax rotation revealed 8 factors whose eigenvalue was >1 for the 28 items with adequate frequency ($>5\%$). This factor resolution explained 71.27% of the variance. According to the scree-plot of TALD-TR items, a four-factorial resolution was considered more appropriate. When factor number was fixed to 4 in the factor analysis, explained variance decreased to 54.65% (Table 5). Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity score was 0.797 for sampling sufficiency. When model fit analysis was conducted using IBM SPSS AMOS, following fit indices were found: Chi-square Mean/Degree of Freedom (CMIN/DF) value: 2.258, Comparative Fit Index (CFI) value: 0.839, Root Mean Square Error of Approximation (RMSEA) value: 0.092, Adjusted goodness-of-fit index (AGFI) value: 0.719. The results of the model fit analysis indicated not perfect but an acceptable fit between the four factorial model and the sample data [21–24].

As the results of the Cronbach's Alpha values of the four factor of TALD-TR, internal consistencies was excellent for the first factor, and were good for Factor II and Factor III and was acceptable for Factor IV (Table 5). It should be noticed that last factor consisted of only two items. Since the most of items loaded into the TALD-TR factors were in line with the original TALD factorial structure, the factor names were determined the same as the original TALD scale (Factor I: Objective

Positive (OP), Factor II: Subjective Negative (SN), Factor III: Objective Negative (ON) and Factor IV: Subjective Positive (SP)). Although *Poverty of content of speech* and *Rupture of thoughts* took place in the Objective Positive factor in the original TALD, these items were loaded on the Objective Negative factor of TALD-TR. In addition, *Semantic paraphasia* was not loaded on any factor. *Phonemic paraphasia* was loaded on the Subjective Positive factor, but when this item was excluded, the Cronbach's Alpha value of the factor increased from 0.29 to 0.53. Thus, this item was not included in the SP factor. Although *semantic paraphasia* and *phonemic paraphasia* were excluded from the factorial score of TALD-TR, they were included in calculating the total TALD-TR score.

The highest significant correlation coefficient of inter-item correlation analysis was found 0.798 (Spearman $r(149) = 0.798, p < 0.001$), the lowest significant correlation coefficient was found 0.161 (Spearman $r(149) = 0.161, p = 0.049$). These results indicated a reliable differential power between the TALD-TR items.

3.4. Relation between TALD-TR factors and PANSS sub-scales

The correlation analyses with TALD-TR and PANSS showed that there are positive correlations between the TALD-TR total score and the PANSS positive ($r(146) = 0.823, p < 0.001$), the PANSS negative ($r(146) = 0.646, p < 0.001$), PANSS general psychopathology ($r(146) = 0.844, p < 0.001$) and PANSS total scores ($r(146) = 0.892, p < 0.001$) (analyses conducted with 146 participants because of missing PANSS data of 3 individuals). The relation between TALD-TR factor scores and PANSS total and subscale scores in the whole group of patients is

Table 6
The relation between TALD-TR factor scores and PANSS total and subscale scores in the whole group of patients ($N = 114$).

PANSS	TALD-TR I	TALD-TR II	TALD-TR III	TALD-TR IV	TALD-TR
	Objective positive	Subjective negative	Objective negative	Subjective positive	Total
Positive	0.766**	0.007	0.159	0.335**	0.757**
Negative	−0.002	0.322**	0.782**	−0.097	0.359**
General psychopathology	0.510**	0.369**	0.362**	0.240**	0.702**
Total	0.555**	0.266**	0.535**	0.243**	0.793**

Spearman: ** $p < 0.01$.

PANSS: Positive and Negative Syndrome Scale.

Table 7

The relation between TALD-TR total score and PANSS items in the whole group of patients (N = 114).

	TALD total
Conceptual disorganization (P2)	0.855*
Unusual thought content (G9)	0.695*
Delusions (P1)	0.694*
Suspiciousness (P6)	0.678*
Poor attention (G11)	0.553*
Grandiosity (P5)	0.533*
Stereotyped thinking (N7)	0.523*
Active social avoidance (G16)	0.523*
Excitement (P4)	0.476*
Lack of judgement & insight (G12)	0.421*
Hallucinatory behavior (P3)	0.417*
Preoccupation (G15)	0.405*

Note: Items whose correlation coefficient was higher than 0.400 were included to the table.

Spearman: *p < 0.01.

presented at Table 6. Significant correlations between TALD-TR total score and PANSS items are shown at Table 7.

When the relationship between TALD-TR factors and PANSS items was evaluated in the whole group of patients, PANSS items that are most correlated with TALD-TR factors were found as Conceptual disorganization item (P2) for the OP factor ($r(114) = 0.810, p < 0.001$), Motor retardation (G7) for the SN factor ($r(114) = 0.434, p < 0.001$), Blunted affect (N1) for the ON factor ($r(114) = 0.743, p < 0.001$) and Poor attention (G11) for the SP factor ($r(114) = 0.374, p < 0.001$). In addition, PANSS P2 had significant correlations with the Subjective Positive factor ($r(114) = 0.335, p < 0.001$) and the Objective Negative factor ($r(114) = 0.250, p = 0.007$). However, PANSS P2 had no significant correlation with the Subjective Negative factor ($r(114) = 0.030, p > 0.05$). There was a significant correlation PANSS N6 and the Objective Negative factor ($r(114) = 0.726, p < 0.001$). A negative significant correlation was found between PANSS N6 and the Objective Positive factor ($r(114) = -0.315, p = 0.001$). However, no significant correlation was detected between PANSS N6 and the Subjective Negative factor ($r(114) = 0.162, p > 0.05$) and the Subjective Positive factor ($r(114) = -0.118, p > 0.05$).

3.5. Formal thought disorder differences between diagnostic groups

MANOVA was performed for between group analyses. TALD-TR factor scores were calculated through the mean TALD-TR factor values. The mania group exhibited the highest mean total score in the OP ($p < 0.001$), whereas the schizophrenia group exhibited the highest mean total score in the ON factor ($p < 0.001$, for the distinct pattern of FTD of each diagnostic group see Table 8).

Table 8

Relation between TALD-TR factor scores and diagnoses (N = 149)*.

	Schizophrenia	Mania	Depression	Controls	F	p
	N = 70	N = 20	N = 24	N = 35		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		
TALD-TR I (OP)	0.74 (0.80) ^a	1.50 (0.63) ^b	0.14 (0.17) ^c	0.02 (0.05) ^c	31.342*	<0.001
TALD-TR II (SN)	0.96 (0.79) ^a	0.18 (0.23) ^b	0.79 (0.71) ^a	0.09 (0.14) ^b	19.290*	<0.001
TALD-TR III (ON)	1.12 (0.77) ^a	0.21 (0.27) ^b	0.33 (0.57) ^b	0.0 (0.0) ^b	35.176*	<0.001
TALD-TR IV (SP)	0.87 (0.97) ^a	1.88 (1.19) ^b	0.56 (0.73) ^{ac}	0.24 (0.39) ^c	15.802*	<0.001

SD: standard deviation

^{abc}Different symbols indicate that the values in the row are significantly different from each other (p < 0.01).

MANOVA results.

* df = 3145.

3.6. Relationship between TALD-TR and clinical characteristics in schizophrenia group

Age controlled partial correlation analysis revealed that there was a positive low degree of correlation between the TALD-TR total score and the duration of illness. Besides, a negative correlation was found between the TALD-TR total score and age at illness onset (Table 9). The overall treatment duration and number of psychotic episodes had no significant correlation with the TALD-TR total score. There was no significant difference between employed and non-employed patients regarding TALD-TR total score ($U = 489.500, p = 0.237$) in the schizophrenia group.

When the schizophrenia group was divided into two treatment groups as clozapine and non-clozapine AP users, clozapine users had higher TALD-TR Objective Negative score than non-clozapine users ($U = 209.000, p = 0.025$, Table 10).

4. Discussion

To our knowledge, this is the first adaptation study of the Thought and Language Disorder (TALD) scale into a different language. This study showed that the Turkish version of TALD (TALD-TR) is a valid and reliable tool with good psychometric properties to assess FTD by its unique four-factorial structure as in the original study [11]. The TALD-TR was able to distinguish the objective and subjective dimensions with a strong construct validity.

In the whole sample, the most frequently observed items of TALD-TR were Rumination and Thought interference and the least frequently observed ones were Verbigeration and Echolalia as in the original TALD study [11]. However, unlike the original study in which *Clanging* was excluded from the factor analysis, *Clanging* was observed at a frequency of %8.1 in TALD-TR and this item was included in the factor analysis. The Turkish version of TALD had high Cronbach's Alpha values for the four factors of OP, SN, ON, SP in accordance with the original validity study. Factor I named Objective Positive was best represented with *Derailment*, *Logorrhoea*, *Circumstantiality* and *Tangentiality*. These items indicate the positive and disorganization component of FTD in accordance with previous studies [13,25,26]. Items of the Objective Positive factor were the same as in the original study. However, the four items which were loaded on the OP factor in the original study, namely *Semantic paraphasia*, *Phonemic paraphasia*, *Poverty of content of speech* and *Rupture of thoughts* were not loaded on the OP factor of TALD-TR. *Semantic paraphasia* was not loaded into any factor and *Phonemic paraphasia* was loaded into the SP factor, but was excluded from the analysis to reach a higher internal consistency. *Poverty of content of speech* and *Rupture of thoughts* were discussed in the Objective Negative factor.

Factor II, the Subjective Negative factor, was best represented with *Poverty of thought*, *Expressive speech dysfunction* and *Blocking*. Although there are few studies in the literature investigating subjective FTD [1,27], subjective phenomena are examined as a different dimension

with TALD and TALD-TR. Both the Turkish version of TALD and the original TALD had the same items loaded in the Subjective Negative factor.

Factor III, the Objective Negative factor consisted of 5 items in the TALD-TR. *Poverty of speech, Slowed thinking, Concretism* were loaded on the ON factor in the original TALD. But factor analysis of TALD-TR revealed that *Rupture of thought* and *Poverty of content of speech* also loaded on the ON factor. Phenomenologically, a negative symptom signifies a lack or loss of a function. In the original TALD manual, *Rupture of thoughts* was defined as “Objectively observed sudden interruption of a previously fluid line of thought” and *Poverty of content of speech* was defined as “Although replies are long enough that speech is adequate in amount, it conveys little information. Language tends to be vague, often overly abstract or overly concrete, repetitive, and stereotyped” [11]. Considering these definitions along with the fact that the Scale of Negative Symptoms also includes Poverty of content of speech as a negative symptom [28], it is not surprising that *Rupture of thought* and *Poverty of content of speech* items as assessed in Turkish language load on the negative factor.

Factor IV, the Subjective Positive factor, had the same items with the original TALD; *Thought interference* and *Pressure/rush of thought*.

Thought and Language Index (TLI) is the only other FTD scale adapted into Turkish [13,29]. Thought and Language Index is considered to have some limitations like absence of subjective symptoms, and being less comprehensive containing only 8 items. There is need for additional material (Thematic Apperception Test) to apply TLI and it is not known whether TLI is valid and reliable for psychiatric illness other than schizophrenia. Due to the abovementioned reasons, TALD-TR could have an important impact in the thorough evaluation of FTD in various psychiatric conditions of Turkish speaking people. Furthermore, it might be suggested that TALD can be successfully adapted to different languages as a tool for international research purposes.

In this study, a strong correlation was found between TALD-TR total score and PANSS Conceptual disorganization item (P2), and PANSS P2 had significant correlation with the OP factor. It may be considered that these results signify TALD-TR validity. Other PANSS items which were highly correlated with TALD-TR total score were Unusual thought content (G9), Delusions (P1), Suspiciousness (P6), Grandiosity (P5), Stereotyped thinking (N7), Active social avoidance (G16), Preoccupation (G15). It should be emphasized that all of these PANSS items are all closely related with thought content. Language is formed by a series of functions which work in harmony with each other such as thinking, speaking, perception, memory, attention [30]. Disruption of this harmony causes thought and language disorders. In other words, linguistic structure of thought consists of production of speech, content of speech and perception of speech which are not completely separate from each other [31]. Thus, the correlation between FTD and PANSS items associated with thought content may be explained by this close relation. Another important explanation for this finding could be that the increase in the volume of speech, which is a phenomenon commonly observed in patients who discuss their distressing and affect related symptoms (such as suspiciousness/persecutory delusions), lead to more severe FTD symptoms. The relation between FTD and Hallucinatory behavior (P3), Excitement (P4) might be considered to be a reflection of a relation between thought process and emotional stress, with some FTD

Table 9
Partial correlations for the TALD-TR factors and clinical parameters in schizophrenia group (N = 70).

	TALD-TR I Objective positive	TALD-TR II Subjective negative	TALD-TR III Objective negative	TALD-TR IV Subjective positive	TALD-TR total
Duration of illness (years)	0.206	0.191	0.209	0.297*	0.344**
Age at illness onset	-0.197	-0.183	-0.239*	-0.285*	-0.342**
Number of psychotic episode	0.232	0.058	-0.015	0.194	0.233
Overall treatment time (months) ^a	-0.001	-0.388**	0.156	0.012	-0.082

* $p < 0.05$.

** $p < 0.01$.

^a For 11 individuals this parameter was incomplete. For this reason, values in the line were belongs to 59 participants of total schizophrenia group.

Table 10
Comparison of FTD in clozapine users and non-clozapine AP users (N = 55)^a.

	Clozapine users N = 18 Median (IQR)	Non-clozapine AP users N = 37 Median (IQR)	U	p
TALD-TR I (OP)	0.38 (0.85)	0.42 (0.92)	331.500	0.978
TALD-TR II (SN)	1.00 (0.75)	0.71 (1.29)	292.500	0.465
TALD-TR III (ON)	1.50 (1.00)	1.00 (1.20)	209.000	0.025
TALD-TR IV (SP)	1.00 (1.63)	1.00 (1.25)	318.000	0.777
TALD-TR total	22.5 (22)	19 (18)	289.500	0.435

^a Mann-Whitney U results, IQR: interquartile range.

symptoms showing an exacerbation under stressful conditions [32]. The other correlated PANSS items, Poor attention (G11) and Lack of judgement & insight (G12) have earlier been reported to be connected with thought process [33–35].

The comparison of FTD among different diagnostic groups showed a distinct pattern regarding the TALD-TR factors. It is noteworthy that the mania group had the highest Objective Positive factor score. Patients with mania were included into study at acute/subacute phase of illness and the schizophrenia group consisted of patients both in psychotic exacerbation phase and in chronic stable phase. The differing illness stages in the two diagnostic groups could have led to a higher severity of the OP factor observed in the mania compared to schizophrenia patients. The Objective Negative factor score was the highest in the schizophrenia group. In addition, schizophrenia and depression groups had higher subjective negative factor scores than mania and healthy control groups. These results are congruent with previous findings [6,11].

Additional analyses performed on schizophrenia patients demonstrate that the severity of FTD was positively correlated with duration of illness and negatively correlated with age at illness onset. Although there was a weak negative correlation between overall AP treatment duration and the Subjective Negative factor score, no correlation was detected between overall treatment duration and FTD severity. Possible explanations for these results could be that FTD is considered as a trait marker for schizophrenia [9,36,37] and drug treatment effects on FTD is limited [1,38,39]. Also FTD is more severe in early onset schizophrenia spectrum disorders [40–42]. Some previous studies found that psychotic exacerbation is related with FTD [43,44], but in this study no such correlation was found. It should be noted that in some patients with schizophrenia, course of illness does not occur with exacerbations.

Another interesting finding is that clozapine users in the schizophrenia group had greater ON factor score than non-clozapine AP users. Groups did not differ regarding total TALD-TR score and other factor scores. The indication for starting clozapine was mainly treatment resistance. Three possible explanations can be listed as: 1) clozapine might have positive effects on all TALD-TR factors except the ON factor in a treatment resistant patient group, 2) some side effects of clozapine such as sedation or anticholinergic effects might enhance the ON symptoms, 3) treatment resistant schizophrenia patients initiated on clozapine have high baseline ON factor score which do not show a further response to clozapine. A longitudinal study design evaluating the treatment response of FTD to clozapine is necessary to clarify this issue.

There are some limitations in this study. The sample size of the mania and depression group is smaller than the other groups. The TALD-TR could not be compared with another valid FTD scale in Turkish. Finally, side effects were not evaluated in detail.

5. Conclusions

The Turkish version of TALD is a valid and reliable tool with good psychometric properties. In line with literature, the results of this study suggest that FTD is related with higher illness severity, longer duration of illness and early age at illness onset in patients with schizophrenia. These findings emphasize the need to develop new treatment strategies aiming to improve FTD from the early stages of schizophrenia. Additionally, this study suggests that thought content and thought process are not completely discrete entities. In patients with treatment refractory schizophrenia, especially the Objective Negative FTD symptoms remain to be one of the main treatment targets. Finally, successful adaptation of TALD into different languages seems to be possible, and such efforts might enable multicentered collaborative international research on FTD.

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