

Manuel J. Cuesta · Victor Peralta

## Thought disorder in schizophrenia. Testing models through confirmatory factor analysis

Received: 13 March 1998 / Accepted: 2 October 1998

**Abstract** Theoretical and empirical models of thought disorder (ThD) were tested through Confirmatory factor analysis (CFA). A sample of 253 DSM-III-R acute schizophrenic patients consecutively admitted was studied. A semistructured interview for schizophrenia was used for diagnosis, and ThD was assessed by means of the Thought, Language, and Communication scale (TLC). Nine ThD models comprising the 18 symptoms of the TLC were tested (ranging from a null model to a six-factor model). The six-dimension model achieved the best fit to the data, although no perfect fit was found. ThD dimensions included in this model were Disorganization, Negative, Idiosyncratic, Semantic, Attentional, and Referential dimensions. The TLC was close to capture adequately these underlying constructs. The Disorganization and the Negative dimensions received more validity on conceptual and psychometric grounds than the remaining dimensions. Thought Disorder multidimensional models fitted the data better than one-dimension models. Thought Disorder dimensions would be potential markers for biological, neurophysiological, and neuropsychological studies of schizophrenic disorder.

**Key words** Thought disorder · Schizophrenia · Psychotic disorder · Thought · Language and communication scale · Psychopathology · Confirmatory factor analysis · LISREL

### Introduction

The symptoms of schizophrenia that psychiatrists believe to be characteristic are changing with time. Four principles have been adopted as characteristic hallmarks of

schizophrenia since its original description: deterioration (Kraepelin 1919); loosening of associations (Bleuler 1924); first-rank symptoms (Schneider 1959), and delusions and hallucinations by extension (David and Appleby 1992); and negative symptoms (Andreasen and Flaum 1991) or 'primary' and 'enduring' negative symptoms (Carpenter et al. 1988). These four symptoms are present in the DSM-IV definition of schizophrenia.

However, in recent years the study of the clinical dimensions underlying positive and negative symptoms have acquired more relevance than the study of the characteristic symptoms in schizophrenia (Liddle 1987; Peralta et al. 1994). At least three dimensions have been repeatedly reported: positive, negative and disorganization dimensions. Moreover, the analysis of these dimensions separately resulted in new sub-dimensions in the positive symptomatology (Cuesta et al. 1994; Peralta et al. 1994) and in the negative symptomatology as well (Peralta and Cuesta 1995).

The disorganization dimension is composed of thought disorder (ThD) and inappropriate affect, and in some studies attention and bizarre behavior are also included. Given the absence of scales aimed specifically at the disorganization dimension, no sub-dimensions have been reported. However, there are standardized and widely used instruments for assessing ThD such as the Thought, Language, and Communication scale (TLC) (Andreasen 1978). Inferences upon the dimensionality underlying ThD may be drawn from studies that report factor analyses of the TLC scale. Andreasen (Andreasen 1979a, 1979b), in her original article describing the TLC, found a bipolar "Verbosity" factor in an exploratory factor analysis. She included only 12 TLC items, and the total variance accounted for by the factor analysis was low (38%). Berenbaum et al. (1985) omitted 10 TLC categories, arguing that they were infrequently scored or overlapped with the remaining categories, and they added a "non-sequitur" category to the scale. These authors found a three-factor solution that accounted for 66% of the variance with a "fluent factor", an "incoherence-derailment" factor, and a third factor made up of poverty of content of speech

Dr. Manuel J. Cuesta  
Psychiatric Unit, Virgen del Camino Hospital,  
c/ Irunlarrea 4, E-31008 Pamplona, Spain  
Fax: +34 948 429924  
e-mail: mj.cuesta.zorita@cfnararra.es

and tangentiality. Andreasen and Grove (1986) reported a three-factor structure including the complete TLC scale with a slight increase in the explained variance over their previous factor analysis (44.1%). Other authors (Taylor et al. 1994) included only the ThD items that corresponded to Andreasen's positive and negative ThD model and reported two factors ("verbiage disturbance" and "disorganized speech" factors) in a mixed sample of 232 psychotic patients. However, studies analyzing all TLC items in schizophrenics or mixed samples found six or seven factors (Peralta et al. 1992; Cuesta and Peralta 1992).

Only one confirmatory factor analysis (CFA) of the TLC has been published (Harvey et al. 1992) although these authors employed only a subset of eight TLC items. A model composed of two factors (verbal productivity and disconnection dimensions) and the three-factor model of Berenbaum et al. achieved the best fit to the data.

The main purpose of this study was to analyze the underlying dimensions of ThD comprised in all TLC symptoms by means of CFA. Competing models obtained from theoretical approximations or from the results of previous factor studies were tested. It is hypothesized that multidimensionality underlies ThD in schizophrenia.

## Methods

The sample was previously studied in two reports; the first concerning the underlying dimensions of positive and negative schizophrenic symptoms through CFA (Peralta et al. 1994), and the second examining underlying dimensions of the negative symptoms group alone (Peralta and Cuesta 1995).

Patients were recruited from consecutive admissions. Subjects were 253 patients who met criteria for DSM-III-R schizophrenia (APA 1987). They were assessed and diagnosed by a semistructured interview (an expanded version of Landmark's Manual for the Assessment of Schizophrenia) (Landmark 1982). Premorbid functioning was evaluated through the Global Assessment Functioning-past year (GAFp) of DSM-III-R and prognosis through the total score on the Strauss-Carpenter scale (Strauss et al. 1972). Response to treatment was assessed by the Guy's CGI efficacy index (1976).

ThD was assessed through Andreasen's Thought, Language, and Communication scale by the two authors. The TLC was scored taking in consideration the intensity of the symptoms presented in the first five days of admission. The interrater reliability was measured by intraclass correlation coefficients (ICC) in a subsample of 33 schizophrenic patients. The two raters obtained good to moderate ICCs (between 0.93 and 0.61) for 13 items of TLC; marginal ICCs for neologisms, circumstantiality, and distractible speech (ICC ranged between 0.59 and 0.41); and poor (ICC < 0.40) for two infrequent symptoms, word approximations and self-reference (Peralta et al. 1992). The total TLC score achieved an excellent intraclass correlation coefficient (ICC = 0.85). Prevalence of TLC symptoms ranged from 3% (echolalia) to 62% (poverty of content of speech) (Table 1).

## Statistical analysis

Confirmatory factor analysis (CFA) was performed through LISREL VI (Jöreskog and Sörbom 1986) and was used to test the goodness-of-fit of the competing models underlying ThD. Good descriptions of this methodology and its applications in the search for latent variables of psychopathological constructs have been

**Table 1** Sample characteristics and prevalence of tlc symptoms

	Mean	SD	Range
Age (yr)	36	3.1	16–79
Education	8.6	3.7	2–18
Age at onset (yr)	25.3	9.7	11–69
Number of prior admissions	4.2	9	1–31
GAFC	25.8	8.8	1–55
GAFp	51.6	13.6	0–85
TLC (Total score)	18.9	14.8	0–85
	Frequency		Rate (%)
Sex (M/F)	170/83		67/33
Civil status (Single/Married/ Divorced/Widowed)	207/26/12/8		82/10/5/3
Patients on neuroleptic treatment	253		100
Patients receiving biperidene	157		62
TLC symptoms	Prevalence		
Poverty of content of speech, illogicality, poverty of speech, tangentiality, derailment, loss of goal and perseverations	Between 40–62%		
Pressure of speech, distractible speech, incoherence and circumstantiality	Between 20–39%		
Clanging, neologisms, word approximations, echolalia, blocking, stilted speech, and self-reference	Between 3–19%		

TLC: Thought, Language, and Communication scale

published (Lenzenweger et al. 1989; Keefe et al. 1992; Peralta et al. 1994).

The input data was the correlation matrix of the 18 TLC items (Table 2). The model's chi-square indicates whether the null hypothesis was confirmed or rejected. A perfect fit between the predicted or "a priori" model and the data would display a non-significant chi-square, a high goodness-of-fit index (GFI) or high adjusted goodness-of-fit index (AGFI). GFI index over 0.8 is considered acceptable and a AGFI index of 0.9 or greater generally indicates a good-fitting model. Another goodness-of-fit measure is the normed chi-square (ratio between  $\chi^2$ /degrees of freedom). Models needing improvement displays  $\chi^2$ /df ratios higher than upper threshold (2.0 or 3.0 or a more liberal limit of 5.0) (Hair et al. 1992).

The maximum likelihood (ML) principle is usually employed as the method to estimate the models through LISREL programs. The ML method is based on the assumption that the observed variables have a multinormal distribution (Jöreskog and Sörbom 1986). However, the item level ratings of TLC data did not meet this assumption because the mean ratings deviate from the center of the rating scale. Therefore, we examined all competing models through the unweighted least squares (ULS) method which is independent of the requirements of multinormal distribution. The interpretation of the fitness of the models through ULS relies in the strength of the goodness-of-fit indexes (Browne and Cudeck 1993). The root mean square residual (RMSR) determines the proportion of the variance not explained by the model. Therefore, high GFI and AGFI and low RMSR indexes suggest better fitting models.

Due to an apparent underidentification of the model resulting in non-positively defined theta-delta matrices, the LISREL program failed to converge on a solution in several models of the study. In these instances, the factor loading of some TLC items of the competing models were constrained to a fixed starting value.

**Table 2** Matrix of intercorrelations between TLC symptoms

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Poverty of speech	0.00																	
2 Poverty of content	0.64	0.00																
3 Pressure of speech	-0.17	0.03	0.00															
4 Distractible speech	0.01	0.10	0.28	0.00														
5 Tangentiality	-0.01	0.14	0.25	0.32	0.00													
6 Derailment	-0.18	0.06	0.30	0.50	0.52	0.00												
7 Incoherence	-0.03	0.11	0.27	0.40	0.37	0.59	0.00											
8 Illogicality	-0.00	0.18	0.06	0.25	0.29	0.54	0.45	0.00										
9 Clanging	-0.03	0.03	0.40	0.25	0.30	0.26	0.36	0.13	0.00									
10 Neologism	0.05	0.04	0.03	0.09	0.18	0.14	0.22	0.15	0.49	0.00								
11 Word approximations	-0.04	0.12	0.12	0.17	0.30	0.33	0.31	0.29	0.21	0.20	0.00							
12 Circumstantiality	0.03	0.22	0.19	0.39	0.48	0.38	0.31	0.25	0.13	0.05	0.24	0.00						
13 Loss of goal	-0.11	0.10	0.23	0.42	0.42	0.80	0.51	0.51	0.26	0.15	0.30	0.32	0.00					
14 Perseveration	0.25	0.49	0.16	0.17	0.12	0.27	0.23	0.32	0.17	0.16	0.26	0.22	0.34	0.00				
15 Echolalia	0.09	0.13	0.13	0.24	0.09	0.21	0.28	0.10	0.29	0.21	0.19	0.13	0.20	0.28	0.00			
16 Blocking	0.13	-0.01	0.06	0.42	0.04	0.18	0.27	0.07	0.06	0.05	0.14	0.02	0.24	0.04	0.13	0.00		
17 Stilted speech	-0.13	-0.10	0.16	0.07	0.17	0.15	0.16	0.23	0.11	0.07	0.36	0.05	0.14	0.05	0.01	0.12	0.00	
18 Self-reference	0.00	0.04	0.26	0.16	0.17	0.18	0.21	-0.01	0.13	-0.01	0.11	0.16	0.11	0.08	0.30	0.08	0.00	0.00

**Table 3** Factor models of thought disorder

**Unidimensional (M1):** All items.

**Negative & Disorganization (M2A).** *Negative dimension* comprised Poverty of speech and Poverty of content items. *Disorganization dimension* the 16 remaining items of TLC.

**Negative (plus blocking) & Positive (M2B).** The same composition of M2A except for the inclusion of blocking within the Negative dimension.

**Verbal-productivity & Disorganization (M2C).** *Verbal-productivity dimension* included Poverty of speech and Pressure of speech. *Disorganization dimension* was composed of the 16-remaining items of TLC.

**Thought, Language, & Communication (M3A).** *Thought dimension* included Poverty of speech and Illogicality. *Language dimension* was composed of Incoherence, Clanging, Neologism, and Word approximations. The *Communication dimension* comprised the 12 remaining items of TLC.

**Fluent-Disorganization, Emptiness, & Linguistic control (M3B).** *Emptiness dimension* comprised Poverty of content of speech and Tangentiality. *Linguistic control dimension* was composed of Clanging, Neologism, Echolalia, Blocking, Stilted speech, and Self-reference. The *Fluent-Disorganization dimension* included the 12 remaining items of TLC.

**Model resulting from the exploratory factor analysis of those patients of the present sample not included in our previous study (M5).** *Disorganization dimension* (Distractible speech, Derailment, Incoherence, Illogicality, and Loss of Goal). *Semantic dimension* (Clanging, Echolalia, and Neologism), *Fluent dimension* (Pressure of speech, Blocking, and Self-reference). *Negative dimension* (Poverty of speech, Poverty of content, and Perseveration), and *Tangential dimension* (Tangentiality, Word approximations, Circumstantiality, and Stilted speech).

**Peralta et al. (M6).** The six dimensions were *Negative dimension* (Poverty of speech, Poverty of content, and Perseveration). *Idiosyncratic dimension* (Word approximations and Stilted speech), *Semantic dimension* (Clanging and Neologism), *Attentional dimension* (Distractible speech and Blocking), *Referential dimension* (Echolalia and Self-reference) and *Disorganization dimension* (Pressure of speech, Tangentiality, Derailment, Incoherence, Illogicality, Circumstantiality, and Loss of Goal).

These modifications did not significantly affect the fit of the model or the parameter estimates.

Eight hypothetical models composed of one to 6 dimensions were tested (Table 3). Moreover, a null model (Model 0) assuming no underlying structure was addressed for the sake of comparability. The one-dimension model (Model 1) was tested assuming a simple severity model. Three competing two-dimension models were evaluated: the positive and negative model (Model 2A) (including poverty of speech and poverty of content of speech in the negative dimension); a second positive and negative model (Model 2B) with a small modification of the model 2A (moving the blocking symptom from the positive to the negative dimension, as in the subscale of alolia in the SANS scale) (Andreasen 1984); and a verbal-productivity and disorganization two-dimension model (Model 2C). This model was based on the proposal of Berenbaum et al. (1985), who considered a factor with excessive or deficient verbal productivity (pressure of speech and poverty of speech) and another factor with the symptoms grouped by disconnection aspects of speech. Although they only studied 9 subtypes of ThD, in our study we consider that the 16 remaining symptoms of TLC could be included in the realm of the disconnection of speech factor.

Two three-dimension models were studied: the hypothetical model of the TLC scale, which comprised Thought, Language, and Communication dimensions, as proposed by Andreasen in her description (Andreasen 1978) (Model 3A), and another three-dimension model obtained from the factor analysis carried out by Andreasen and Grove (1986) (Model 3B). This model comprised a fluent-disorganization factor, an Emptiness factor, and a Linguistic control factor. Finally, a model resulting from a previous factor analysis of our group (Peralta et al. 1992) (Model 6) was tested. This model was originally composed of seven factors. However, since only one symptom (pressure of speech) obtained high loading in the seventh factor and a dimension needs at least two variables to be incorporated in the CFA, the most recommended approach to this problem is to load these symptoms in the first dimension. Therefore, this model included six dimensions: Disorganization, Negative, Idiosyncratic, Semantic, Attentional, and Referential (Table 3). Moreover, given that the patients of the study of Peralta et al. (1992) were included in this study, we decided to carry out another exploratory factor analysis in the total sample without these 115 patients of the previous study. This analysis resulted in another 5 dimension model which was also tested with CFA in the total sample (Table 3).

**Table 4** Confirmatory factor analysis of TLC models

Models	$\chi^2$	df	$\chi^2/df$	$p <$	GFI	AGFI	RMSR
Null (M0)	2391.81	153	15.63	0.000	0.487		
One-dimension (M1)	666.30	135	4.93	0.000	0.906	0.881	0.101
Negative & disorganization (M2 A)	531.45	135	3.94	0.000	0.924	0.904	0.091
Negative (plus blocking) & disorganization (M2 B)	550.09	135	4.07	0.000	0.911	0.887	0.098
Verbal-productivity & disorganization (M2 C)	665.53	134	4.96	0.000	0.908	0.882	0.100
Thought, language & communication (M3 A)	660.19	132	5.00	0.000	0.908	0.881	0.099
Fluent-disorganization, emptiness, & linguistic control (M3 B)	649.12	132	4.92	0.000	0.907	0.880	0.100
Five-dimension model (M5)	453.07	125	3.62	0.000	0.936	0.913	0.083
Peralta et al. (M6)	412.24	120	3.43	0.000	0.945	0.922	0.077

GFI: Goodness-of-fit index.  
RMSR: Root Mean Square  
Residual. AGFI: Adjusted  
goodness-of-fit index

## Results

The null model that assumes no underlying structure among the TLC variables obtained a fairly low goodness-of-fit index (GFI). This suggests that a latent structure underlying TLC symptoms in schizophrenic patients is likely (Table 4). The remaining seven models estimated by means of CFA achieved moderate to good fits with the data. The best fitting model in this study was the model of Peralta et al. (1992) which obtained good fit indexes (GFI and AGFI both greater than 0.9) and the lowest RMSR (RMSR = 0.077). Also, this model achieved both the lowest  $\chi^2$  and normed chi-square. The goodness-of-fit for the model resulting in the sample not included in our first study (Peralta et al. 1992) (Model 5) was slightly worse than those of the Model 6 (Table 4).

The good fitness does not preclude the amount of variance of the latent construct accounted for by the items loaded in each of the two TLC factors. This parameter can be computed through estimating the variance extracted (VE) measure only in models which obtained good fitness (Hair et al. 1992). VE can be computed by dividing the sum of squared standardized loadings by the sum of squared standardized loadings plus the sum of the indicator measures of error. VE over 0.50 reflects acceptability of the underlying construct (Hair et al. 1992). The VE values for the dimensions of the model 6 were slightly low for the Disorganization dimension (VE = 0.43), near the recommended value for the Negative dimension (VE = 0.48) and Idiosyncratic dimension (VE = 0.48), slightly higher for the Semantic dimension (VE = 0.55) and Attentional dimension (VE = 0.55), and very low for the Referential dimension (VE = 0.33). These results suggested that the symptoms included within the Negative, Idiosyncratic, Semantic, and Attentional dimensions explained the latent construct slightly better than the items of the Disorganization dimension and very much better than the Referential dimension.

## Discussion

These results suggested that ThD is best understood as a multidimensional construct. Models composed of two or

more dimensions fitted the data better than null or one-dimension models. Nonetheless, we found no definitive answer to the question of how many dimensions underlie the TLC items, because no perfect fit was achieved. When the 18 TLC items were examined, the model that obtained the best fit (GFI = 0.945; AGFI = 0.922; RMSR = 0.077) comprised six underlying dimensions: Disorganization, Negative, Idiosyncratic, Semantic, Attentional and Referential dimensions. Moreover, the items including in these dimensions had good or near the recommended value of explained variance of their latent constructs, with the exception of the Referential dimension. These results indicated that this 6-dimension model was sufficient in their representation of the underlying constructs.

The multidimensionality underlying ThD is in accordance with the heterogeneity of ThD, which was already reported before the TLC was developed (Andreasen 1979a). It is also in agreement with the results of previous exploratory factor analyses, since six or more factors arose in three studies whenever the 18 TLC items were examined (Peralta et al. 1992; Cuesta and Peralta 1992). Analysis of a smaller number of TLC symptoms revealed fewer factors (Andreasen 1979b; Berenbaum et al. 1985; Harvey et al. 1992; Taylor et al. 1994).

The TLC scale is composed of a large set of symptoms whereby a number of items included may have been redundant in the representation of the hypothetical constructs. Furthermore, many symptoms had a very low prevalence in the schizophrenic population (below 20%, see Table 1), and these were usually less reliable. In spite of these caveats, the results of this study concluded that the TLC was close to capture adequately the constructs underlying ThD. Moreover, the ThD constructs underlying the TLC receive validity on *conceptual and psychometric grounds*.

*Conceptual validity* is given by the fact that many of the symptoms included in the TLC have been widely recognized by the psychiatric literature as representative ThDs since the beginning of the century. Kraepelin defined ThD as the "loss of internal and external connections of the chains of ideas" or as "loss of internal unity" ("Zerfahrenheit") and Bleuler named it "loosening of associations" (Sass 1992). Phenomenologists emphasized

the subjective experience of ThD and its comprehensibility, and later Andreasen chose observable ThD (verbal behavior), aiming for high reliability. The descriptive or behavioral-oriented approach is held to be a better approach by the scientific community than the phenomenological-oriented approach, although this discussion is not definitively closed (Sass 1992).

The TLC scale is one of the most frequently used instruments for the assessment of ThDs; it is one of the “buildings” of current psychopathologic instruments and its psychometric properties have been reported. The TLC has good *interrater reliability* (Andreasen 1979a; Andreasen and Grove 1986; Davis et al. 1986). ThD evaluated through the TLC has shown stability within a 10-day period, suggesting good *test-retest reliability* (Harvey et al. 1984). Results regarding *face validity* of the TLC were reported through comparisons with other scales. The BPRS subscale of ThD accounted for only half of the variance of ThD measured by TLC (Thieman et al. 1987), and no significant correlation was found between the TLC scores and instruments designed to assess “fine-grained linguistic impairments” (Anand et al. 1994). However, ‘cloze’ procedures have been found to be significantly associated with the Negative ThD (Ragin and Oltmanns 1983, 1987). Otherwise, poor linguistic reference performance has been demonstrated to be associated with the Positive ThD in acute schizophrenics (Docherty et al. 1994) and in a mixed sample of schizophrenics and manics (Docherty et al. 1988). Several studies have addressed the *discriminant validity* of TLC. ThD in schizophrenics can be distinguished from ThD in aphasic patients (Gershon et al. 1977; Faber et al. 1983). However, many studies failed to find discriminant validity of ThDs between psychotic disorders. This may be because only global indexes of ThD were studied since when ThD specific symptoms were compared among psychotic disorders, a differential profile was found (Cuesta and Peralta 1992; Taylor et al. 1994). *Factor validity* has been addressed in several articles, and a multifactorial but not definitive structure has been reported. Evidence in favor of the multidimensionality of ThD of the TLC are greater than ThD considered as one unique severity dimension.

*External validation* arose from neuropsychological, response to treatment, and prediction of outcome studies.

ThD within the Disorganization dimension (i.e. measures of associative ThD or the bizarre-idiosyncratic thinking) have been related to performance in attention and information processing tasks (Asarnow and MacCrimmon 1982). In addition, they were related to neuropsychological disturbances (Silverstein and Arzt 1985), linked to disturbances in intellectual and arithmetic functions (Silverstein et al. 1993), and associated with deficits in semantic access and manipulation tasks (Mortimer 1995). Likewise, the Negative ThD (alogia) and verbal fluency are closely related, and it has been hypothesized that Disorganization and Negative ThD are mediated by the same underlying cognitive abnormality, reflecting a frontostriatal dysfunction (Joyce et al. 1996). Even though for other authors, these two dimensions of ThD exhibited different profiles of lateralized neuropsychological dysfunction (Silverstein et al. 1991). Moreover, recent findings coming from the study of semantic networks led support to different neurobiological evidences for two dimensions of ThD. Spitzer et al. (1995) found that the Disorganization dimension of ThD was associated with an increase of semantic priming. This increase in semantic priming has been related to a typical finding in information processing in schizophrenic patients: the impaired sensory gating (Vinogradov et al. 1996). Also, it has been hypothesized a decreased signal/noise ratio and a hypodopaminergic status that produces an unfocused activation of the semantic network as the possible underlying neural mechanism accounting for this Disorganization dimension (Cohen and Servan-Schreiber 1993). On the contrary, the psychomotor poverty syndrome which including alogia (Negative ThD) was associated with a normal semantic priming (Williams 1996). No similar studies have been focused in the remaining ThD dimensions.

*Response to treatment* studies demonstrated that the Negative ThD was associated with poor response and the Positive ‘manic’ ThD with good response to treatment (Cuesta et al. 1994). Moreover, Negative ThD was indicative of poor prognosis in the short term (Harvey et al. 1990) and in the long term (Knight et al. 1986).

Lastly, external validation of the best fitting models of TLC compared with the severity or one-dimension model was carried out (Table 5) through correlation procedures. The Disorganization and the Negative dimen-

**Table 5** External validation of ThD competing models

	Gender	Age at onset	Years of evolution	Education	GAFP <sup>a</sup>	No. of admiss.	Strauss <sup>b</sup> -Carpenter	Response treatment
M1	0.07	<b>-0.26***</b>	-0.02	-0.10	-0.09	0.03	-0.14**	0.17**
M6								
Disorganization	0.04	<b>-0.26***</b>	-0.01	-0.04	-0.01	0.02	-0.07	0.08
Negative	0.04	-0.11*	-0.17**	<b>-0.21***</b>	<b>-0.31***</b>	0.10	<b>-0.33***</b>	<b>0.34***</b>
c .....								

<sup>a</sup> GAFP (Global Assessment Functioning-past year)

<sup>b</sup> Strauss-Carpenter total scale

<sup>c</sup> No other dimensions of the 6-dimension model achieved significant relationship

\* =  $p < 0.05$  \*\* =  $p < 0.01$  \*\*\* =  $p < 0.001$

Regarding Bonferroni correction all set of correlations \*\*\* were at a significant level (correlations in bold)

sions of the six-dimension model had more significant correlations with our clinical and epidemiological variables than the severity model of ThD. The Disorganization dimension was highly correlated with an earlier onset of the illness. Whereas lower level of education, lower adjustment in the past year, lower scores in Strauss-Carpenter scale, and poor response to treatment were associated with the Negative dimension of ThD. Thus, the type of ThD presented in acute episodes of schizophrenic patients provided more information than ThD considered merely as a global index.

Taken together, good reliability and moderate results concerning validity make the TLC a well-suited instrument to the assessment of ThD. The Negative and the Disorganization dimensions achieved good conceptual and psychometric validity. The remaining ThD dimensions obtained relatively good psychometric properties in this study (high parameters of goodness of fit of the model of 6 dimensions and good variance extracted measures), though no specific conceptual or experimental studies have been reported to validate these ThD dimensions. Moreover, five TLC items only achieved low inter-rater reliability ( $< 0.59$ ). Four of these five items (Word approximations, Neologism, Self-reference and Distractible speech) were included in dimensions comprising only two items. Therefore, conclusions relying in Idiosyncratic, Semantic, Attentional, and Referential dimensions should be taken with caution.

Certain methodological and statistical limitations of the present study should be taken into account. First, the cross-sectional assessment of this study is a limitation because schizophrenic speech deteriorated over prolonged periods of time (King et al. 1990). Moreover, only the acute thought disorder was examined in this study since patients were evaluated during a exacerbation of the schizophrenic illness. However, it has been reported in a recent longitudinal study of ThD in schizophrenic patients "...thought disorder is not simply a function of psychosis..." since it persisted along the course of the disorder. And this fact differentiated the ThD of schizophrenic patients with respect to other schizoaffective and other psychotic patients (Marengo and Harrow 1997).

Second, the sample was heterogeneous, though long-lasting patients predominated. Influences derived from the duration of illness could not be eliminated. Another limitation may be that all patients were taking medication, and neuroleptics have substantial effects on ThD related to acute episodes (Spohn et al. 1986; Gold et al. 1990). Third, differences in ratings of TLC may account for the discrepancy with the results of other authors. Finally, other psychotic disorders have to be examined in order to ascertain if their ThD structure differs from schizophrenia.

Two additional possible statistical limitations should be borne in mind. This study is based upon the factor model, which presumes a general linear additive model. This assumption may not fit adequately with the TLC symptoms if their distributions were non-linear. And secondly, another caveat derives from the CFA studies. The better fitness achieved by our models does not rule out the possibility that other models might fit better.

Notwithstanding, given that ThD are true signs, obtained directly through the interview and less influenced from the subjective "filter" of the patient than other psychotic symptoms (i.e., hallucinations and delusions), it would be hypothesized that the dimensions of TLC would be strong markers for biological, neuropsychological, and neuroimaging research in schizophrenia.

The present results should be also considered as a contribution to the re-evaluation of current instruments of psychopathological assessment. Andreasen et al. (1995, p. 8) recently reported: "Now that a decade has passed, however, we have begun the process of making additional appropriate revisions in the scales". In this respect, a specific disorganization scale, in addition to positive and negative scales, is eagerly awaited now that the trisyn-dromic structure of positive and negative schizophrenic syndromes is widely accepted.

**Acknowledgments** The authors thank Joan Guàrdia, Ph. D., Professor of the Psychology School of Barcelona University, for statistical assistance.

## References

- American Psychiatric Association (1987) *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed) (DSM-III-R). Washington DC: APA
- Andreasen NC (1978) *The Scale for the Assessment of Thought, Language and Communication Disorders (TLC)*. Iowa City: The University of Iowa
- Andreasen NC (1979a) Thought, Language and Communication disorders: I. Clinical assessments, definition of terms and evaluation of their reliability. *Archives of General Psychiatry* 36: 1315–1321
- Andreasen NC (1979b) Thought, Language and Communication disorders: II. Diagnostic significance. *Archives of General Psychiatry* 36: 1325–1330
- Andreasen NC (1984) *Scale for the Assessment of Negative Symptoms (SANS)*. Iowa City: The University of Iowa
- Andreasen NC, Grove WM (1986) Thought, Language and Communication in schizophrenia: Diagnosis and prognosis. *Schizophrenia Bulletin* 12, 3: 348–359
- Andreasen NC, Flaum M (1991) Schizophrenia: The characteristics symptoms. *Schizophrenia Bulletin* 17: 27–49
- Andreasen NC, Arndt S, Miller D, Flaum M, Nopoulos P (1995) Correlational studies of the scale for the assessment of negative symptoms and the scale for the assessment of positive symptoms: An overview and update. *Psychopathology* 28: 7–17
- Anand A, Wales RJ, Jackson HJ, Copolov DL (1994) Linguistic impairment in early psychosis. *Journal of Nervous and Mental Disease* 182: 488–493
- Asarnow RF, MacCrimmon DJ (1982) Attention/Information processing, neuropsychological functioning, and thought disorder during the acute and partial recovery phases of schizophrenia: a longitudinal study. *Psychiatry Research* 1: 309–319
- Berembaum H, Oltmanns TF, Gottesman II (1985) Formal Thought Disorder in schizophrenic patients and their twins. *Journal of Abnormal Psychology* 94: 3–16
- Bleuler E (1924) *Textbook of Psychiatry*. Translated by A.A. Brill. New York: MacMillan
- Browne MW, Cudeck R (1993) Alternative ways of assessing model fit. In: Bollen KA, Long J Scott (eds) *Testing Structural Equation Models*. Newbury Park, Sage Pu. Inc., California, pp 136–162
- Carpenter WT, Heinrichs DW, Alphas LD (1988) Deficit and non-deficit forms of schizophrenia: the concept. *American Journal of Psychiatry* 145: 578–583

- Cohen JD, Servan-Schreiber D (1993) A theory of dopamine function and its role in cognitive deficits in schizophrenia. *Schizophrenia Bulletin* 19:85–104
- Cuesta MJ, Peralta V (1992) Alteraciones formales del pensamiento en trastornos esquizofrénicos, esquizofreniformes y esquizoafectivos maníacos. *Actas Luso-Españolas de Psiquiatría* 20, 2: 61–70
- Cuesta MJ, Peralta V, De Leon J (1994) Schizophrenic syndromes associated with treatment response. *Progress in Neuro-Psychopharmacology and Biological Psychiatry* 18:87–99
- David AS, Appleby L (1992) Diagnostic criteria in schizophrenia: Accentuate the positive. *Schizophrenia Bulletin* 16:551–557
- Davis GC, Simpson DM, Foster D, Arison Z, Post M (1986) Reliability of Andreasen's Thought, Language and Communication disorder scale. *Hillside Journal of Clinical Psychiatry* 8: 25–33
- Docherty NM, Schnur M, Harvey PD (1988) Reference performance and positive and negative thought disorder: A follow-up study of manics and schizophrenic patients. *Journal of Abnormal Psychology* 97:437–442
- Docherty NM, Evans IA, Sledge WH, Seibyl JH, Krystal JH (1994) Affective reactivity of language in Schizophrenia. *Journal of Nervous and Mental Disease* 182:98–102
- Faber R, Abrams R, Taylor MA, Kasprisin S, Morris C and Weiss R (1983) A comparison of schizophrenic patients with formal thought disorder and neurologically impaired patients with aphasia. *American Journal of Psychiatry* 140:1348–1351
- Gershon S, Benson DF, Frazier SH (1977) Diagnosis: schizophrenia versus posterior aphasia. *American Journal of Psychiatry* 134:966–999
- Gold JM, Hurt SW (1990) The effects of haloperidol on thought disorder and IQ in schizophrenia. *Journal of Personality Assessment* 54:390–400
- Guy W (1976). *ECDEU Assessment Manual for Psychopharmacology*. US Department of Health, Education and Welfare. Washington D.C.
- Hair JF, Anderson RE, Tatham RI, Black WC (1992) *Multivariate analysis*. 3rd ed. New York: MacMillan Publishing Company
- Harvey PD, Earle-Boyer EA, Wielgus MS (1984) The consistency of Thought Disorder in Mania and Schizophrenia. An assessment of acute psychotics. *Journal of Nervous and Mental Disease* 172:458–463
- Harvey PD, Docherty NM, Serper MR, Rasmussen M (1990) Cognitive deficits and thought disorder: II. An 8-month follow-up study. *Schizophrenia Bulletin* 16:147–156
- Harvey PD, Lenzenweger MF, Keefe RSE, Pogge DL, Serper MR, Mohs RC (1992) Empirical assessment of the factorial structure of clinical symptoms in schizophrenic patients: Formal Thought Disorder. *Psychiatry Research* 44:142–151
- Jöreskog KG, Sörbom D (1986) *LISREL VI: An analysis of Linear Structural Relationships by Maximum Likelihood, Instrumental variables, and Least Squares Methods* (4th ed) Sweden: Scientific Software Inc
- Joyce EM, Collinson SL, Crichton P (1996) Verbal fluency in schizophrenia: relationship with executive function, semantic memory and clinical alogia. *Psychological Medicine* 26:39–49
- Keefe RS, Harvey PD, Lenzenweger MF, Davidson M, Apter SH, Schmeidler J, Mohs RC, Davis KL (1992) Empirical assessment of the factorial structure of clinical symptoms in schizophrenic patients: Negative Symptoms. *Psychiatry Research* 44:153–165
- King K, Fraser WI, Thomas P, Kendell RE (1990) Re-examination of the language of psychotic subjects. *British Journal of Psychiatry* 156:211–215
- Knight RA, Elliot DS, Roff JD, Watson CG (1986) Concurrent and predictive validity components of disordered thinking. *Schizophrenia Bulletin* 12:427–446
- Kraepelin E (1919) *Dementia Praecox and Paraphrenia*. Translated by R.M. Barclay, Edinburgh, EQ Livingstone
- Landmark J (1982) A manual for the assessment of schizophrenia. *Acta Psychiatrica Scandinavica* 65 [Suppl 268]:1–88
- Lenzenweger MF, Dworkin RH, Wethigton E (1989) Models of positive and negative symptoms in schizophrenia: An empirical evaluation of latent structures. *Journal of Abnormal Psychology* 98:62–70
- Liddle PF (1987) The symptoms of chronic schizophrenia: A re-examination of positive-negative dichotomy. *British Journal of Psychiatry* 151:145–151
- Marengo JT, Harrow M (1997) Longitudinal course of thought disorder in schizophrenia and schizoaffective disorder. *Schizophrenia Bulletin* 23:273–285
- Mortimer A, Corridan B, Rudge S, Kho K, Kelly F, Bristow M, Hodges J (1995) Thought, speech and language disorder and semantic memory in schizophrenia. In: Sims A (ed) *Speech and Language Disorders in Psychiatry*. Gaskell. London
- Peralta V, Cuesta MJ, De Leon J (1992) Thought disorder in schizophrenia: A factor analytic study. *Comprehensive Psychiatry* 33, 2:105–110
- Peralta V, Cuesta MJ, De Leon J (1994) An empirical analysis of latent structures underlying schizophrenic syndromes: A four-syndrome model. *Biological Psychiatry* 36:726–736
- Peralta V, Cuesta MJ (1995) Negative symptoms in schizophrenia: A confirmatory factor analysis of competing models. *American Journal of Psychiatry* 152:1450–1457
- Ragin AB, Oltmanns TF (1983) Predictability as an index of impaired verbal communication in schizophrenic and affective disorders. *British Journal of Psychiatry* 143:578–583
- Ragin AB, Oltmanns TF (1987) Communicability and thought disorder in schizophrenics and other diagnostic groups. *British Journal of Psychiatry* 150:494–500
- Sass H (1992) Phenomenological aspects on "Zerfahrenheit" and Incoherence. In: Spitzer M, Uehlein F, Schwartz MA, Mundt C (eds) *Phenomenology, Language and Schizophrenia*. Springer New York, pp 147–159
- Schneider K (1959) *Clinical Psychopathology*. Grune & Stratton, New York
- Silverstein ML, Arzt AT (1985) Neuropsychological dysfunction in schizophrenia. Relation to associative thought disorder. *Journal of Nervous and Mental Disease* 173:341–346
- Silverstein ML, Marengo JT, Fogg L (1991) Two types of thought disorder and lateralized neuropsychological dysfunction. *Schizophrenia Bulletin* 17:679–687
- Silverstein ML, Harrow M, Marengo JT (1993) Disordered thinking and cerebral dysfunction: laterality effects, language, and intellectual functions. *Archives of Clinical Neuropsychology* 8:497–505
- Spitzer M (1995) Conceptual developments in the neurosciences relevant to psychiatry. *Current Opinion in Psychiatry* 8:317–329
- Spohn HE, Coyne L, Larson J, Mittleman F, Spray J, Hayes K (1986) Episodic and residual thought pathology in chronic schizophrenics: effect of neuroleptics. *Schizophrenia Bulletin* 12:394–407
- Strauss JS, Carpenter WT (1972) The prediction of the outcome in schizophrenia. II: Relationships between predictor and outcome variables. *Archives of General Psychiatry* 31:37–42
- Taylor MA, Reed R, Berembaum S (1994) Patterns of speech disorders in schizophrenia and mania. *Journal of Nervous and Mental Disease* 182:319–326
- Thiemann S, Csernansky JG, Berger PA (1987) Rating scales in research: The case of negative symptoms. *Psychiatry Research* 20:47–55
- Vinogradov S, Solomon S, Ober BA, Biggins CA, Shenaut GK, Fein G (1996) Do semantic priming effects correlate with sensory gating in schizophrenia? *Biological Psychiatry* 39:821–824
- Williams LM (1996) Cognitive inhibition and schizophrenic symptom subgroups. *Schizophrenia Bulletin* 22:139–151