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The affective reactivity of psychotic speech: The role of internal source monitoring in explaining increased thought disorder under emotional challenge

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ABSTRACT

Thought disorder (TD) has been shown to vary in relation to negative affect. Here we examine the role internal source monitoring (iSM, i.e. ability to discriminate between inner speech and verbalized speech) in TD and whether changes in iSM performance are implicated in the affective reactivity effect (deterioration of TD when participants are asked to talk about emotionally-laden topics). Eighty patients diagnosed with schizophrenia-spectrum disorder and thirty healthy controls received interviews that promoted personal disclosure (emotionally salient) and interviews on everyday topics (non-salient) on separate days. During the interviews, participants were tested on iSM, self-reported affect and immediate auditory recall. Patients had more TD, poorer ability to discriminate between inner and verbalized speech, poorer immediate auditory recall and reported more negative affect than controls. Both groups displayed more TD and negative affect in salient interviews but only patients showed poorer performance on iSM. Immediate auditory recall did not change significantly across affective conditions. In patients, the relationship between self-reported negative affect and TD was mediated by deterioration in the ability to discriminate between inner speech and speech that was directed to others and socially shared (performance on the iSM) in both interviews. Furthermore, deterioration in patients' performance on iSM across conditions significantly predicted deterioration in TD across the interviews (affective reactivity of speech). Poor iSM is significantly associated with TD. Negative affect, leading to further impaired iSM, leads to increased TD in patients with psychosis. Avenues for future research as well as clinical implications of these findings are discussed.

1. Introduction

Thought disorder (TD) is a common (Tan et al., 2014) and enduring feature of psychosis (Marengo and Harrow, 1987, 1997) that is associated with poorer occupational (Racenstein et al., 1999) and social functioning (Bowie and Harvey, 2008), poorer quality of life (Tan et al., 2014) and relapse in patients (Wilcox, 1990), and transition to psychosis in high-risk populations (Bearden et al., 2011). As there is a lack of evidence-based psychological treatments for TD (Beck et al., 2009) there is a pressing need to understand the mechanisms that underlie it.

Hyperpriming in semantic memory (i.e. hyper-activation of semantically-related nodes) has been proposed as one such mechanism (Spitzer, 1997). However, a meta-analysis failed to find significant differences between TD and non-TD patients (Pomarol-Clotet et al., 2008) on this. An alternative theory implicates difficulties with theory-of-mind (ToM, Hardy-Baylé et al., 2003) which could explain difficulties sharing topics and misalignment in conversation. Indeed impairments in ToM, although not specific, are highly associated with TD (Sprong et al., 2007) but these difficulties alone are unlikely to explain incoherent speech.

1.1. Internal source monitoring (iSM)

iSM refers to the ability to discriminate between self-generated private stimuli such as inner speech, and self-generated speech that is directed to others (Johnson et al., 1993) (iSM is different from external source monitoring implicated in hallucinations, in which the individual distinguishes between inner speech and the *heard* speech of others, Brookwell et al., 2013). Harvey (1985) reported and subsequently replicated (Harvey et al., 1988; Harvey and Serper, 1990) an association between TD in schizophrenia patients and a bias towards over-reporting words as having been verbalized when they had only been thought. Nienow and Docherty (2004) replicated this finding controlling for IQ and working memory and, in a later study, reported a significant association between these biases and communication disturbances (Nienow

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and Docherty, 2005). More recently, Docherty (2012) tested patients using both iSM and an external source-monitoring task. Again, performance on the former was found to be a significant predictor of communication disturbances even after controlling for performance on the external source-monitoring, immediate recall and working memory.

1.2. Affect

The exacerbation of communication difficulties during discussion of affectively-laden topics has been termed *affective reactivity of speech* and has been observed in schizophrenia (Docherty, 1996; Haddock et al., 1995) and bipolar disorder (Tai et al., 2004). For example, Docherty and colleagues tested schizophrenia patients using two speech tasks in which they had to discuss stressful or pleasant experiences; participants displayed more TD in the stressful condition (Docherty et al., 1994a, 1994b).

The affective reactive of speech in TD is a well-replicated phenomenon (e.g. Docherty et al., 1994a; Docherty, 1996; St-Hilaire and Docherty, 2005) but its cause is unknown. Here we attempt to explore whether a specific psychological mechanism known to be associated with TD – internal source monitoring, as reviewed above – is also affectively reactive and may therefore explain the affective state-dependent deterioration in social speech observed in thought-disordered patients (i.e. affective reactivity of speech).

2. Materials and methods

2.1. Participants

Eighty participants (see Table 1) were recruited from mental health sites in the UK. The recruitment targeted 18–65 year olds with a diagnosis of schizophrenia-spectrum disorder (WHO, 2004). PS confirmed all the diagnoses with the use of a clinical interview (i.e. PANSS) and the patient's clinical history. All participants provided informed consent according to the Declaration of Helsinki. We excluded participants whose first language was not English, who had severe learning difficulties, recent substance abuse or history of medical disorders that could affect brain function. Antipsychotic medications were converted to chlorpromazine-equivalents as per agreed conventions (Woods, 2003).

For comparison purposes, thirty healthy participants were recruited through advertisements in the community. An attempt was made to select participants who were approximately comparable for age, gender and ethnicity with participants in the clinical group.

2.2. Materials

2.2.1. Psychotic symptoms

Psychotic symptoms were measured using the Positive and Negative Syndromes Scale (PANSS, Kay et al., 1987) that measures 30 symptoms, comprising a positive, a negative, and a general psychopathology scale. Each item is scored from 1 to 7 with the higher score indicating increased severity. The scale has been found to have good psychometric properties (Kay et al., 1987).

2.2.2. IQ

Intelligence was evaluated using the Quick test (QT, Ammons and Ammons, 1962) in which the participant is presented with four pictures (e.g. a policeman stopping the traffic with a whistle) and is asked to identify fifty words by pointing to the appropriate card where the word referent can be found (e.g. "whistle"). The final score is achieved by summing the number of words correctly identified and scores are converted using standardized guidelines (Ammons and Ammons, 1962).

2.2.3. Interviews

Speech samples were gathered using two interviews that had been previously developed to elicit TD (Tai et al., 2004). The salient interview involved fifteen questions that promoted self-disclosure by asking for negative autobiographical memories, whereas the non-salient interview included fifteen questions about neutral topics (see Appendix 1). Means and standard deviations for duration of the interviews and word-counts can be seen in Table 2.

2.2.1. TD

Speech samples were rated by two independent raters, one of whom was blind to the study hypotheses, using the 18-items of the Scale for the Assessment of Thought, Language and Communication (TLC, Andreasen, 1986). The total is achieved by summing the items scores. The scale has good psychometric properties (Andreasen, 1979, 1986). Table 2 shows the means and standard deviations for the total scores.

Table 1
Clinical and demographic variables.

		Patients	Comparisons	
Sample size		80	30	
Gender (%)	Male	58 (72.5%)	21 (70%)	$\chi^2 = .067; p = .795$
	Female	22 (27.5%)	9 (30%)	
Ethnicity (%)	White British	74 (92.5%)	28 (93.3%)	$\chi^2 = .006; p = .936$
	Other	6 (7.5%)	2 (6.6%)	
Age (years)		39.3 (11.6)	38.4 (13.3)	$t = .33; p = .746$
Years of education		**11.2 (1.9)**	**12.7 (2.3)**	$\boldsymbol{t = -3.35; p = .001}$
IQ		**98.4 (10.6)**	**109.5 (8.3)**	$\boldsymbol{t = -5.18; p < .005}$
Diagnoses (%)	Schizophrenia (F20)	48 (60%)	N/A	
	Schizoaffective (F25)	18 (22.5%)	N/A	
	Other Psychoses (F29)	14 (17.5%)	N/A	
Duration of illness (years)		15.2 (10.9)	N/A	
History of admission (yes)		73 (91.3%)	N/A	
FGA (%)		26 (23.6%)	0 (0%)	
SGA (%)		58 (72.5%)	0 (0%)	
'Mood stabilizers' (%)		14 (17.5%)	0 (0%)	
Anti-depressants (%)		31 (38.7%)	0 (0%)	
Equivalent CPZ dose (mg)		469.7 (389.1)	N/A	
PANSS	Positive	17.1 (5.2)	N/A	
	Negative	14 (4.7)	N/A	
	General	38.6 (9.2)	N/A	
	Total	69.8 (16.1)	N/A	

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Table 2
Means and standard deviations for TD, iSM scores, DST and reported affect across group and interview.

	Neutral condition				Salient condition			
	Patients		Comparisons		Patients		Comparisons	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TD	8.16	6.14	1.77	2.02	12.35	9.31	3.93	2.79
Duration (min:s)	15:03	01:34	15:03	00:22	15:15	02:13	15:02	00:25
Word count	1388.04	556.26	2046.37	315.14	1424.45	622.57	2042.93	359.13
Recognition score[a]	.60	.14	.74	.10	.50	.17	.72	.10
Discrimination index[b]	.68	.14	.77	.13	.57	.19	.76	.12
Say-report-think errors[c]	.27	.19	.30	.19	.33	.21	.29	.19
Think-report-say errors[d]	.26	.21	.10	.10	.38	.28	.13	.13
DST forward	6.25	1.45	7.33	.99	6.25	1.33	7.4	.77
DST backward	4.86	1.52	6.2	.84	4.71	1.49	6	1.23
Positive affect[e]	32.5	7.7	34.6	6.4	27.7	8	29.4	7.8
Negative affect[e]	14.5	5.2	11.1	1.6	23.6	7.6	16.4	4.8

[a] Correctly identified words as old and new divided by 24.
[b] Thought and said words correctly identified divided by the total amount of old words correctly identified.
[c] Said words that were reported as being thought divided by 8.
[d] Thought words that were reported as being said divided by 8.
[e] Scores range from 0 to 50.

2.2.2. Affect

Affect was measured with the positive and negative affect scale (PANAS, Watson et al., 1988) which assesses positive and negative mood using 20 words (e.g. excited, jittery, nervous) rated by participants according to how they felt during the interview using a five-point scale. The measure has good psychometric qualities (Watson et al., 1988). Means and standard deviations for both groups across interviews can be seen in Table 2.

2.2.3. iSM

iSM was measured using a task developed by Nienow and Docherty (2004, 2005). Sixteen cards with a statement and a self-evident missing word are presented sequentially (e.g. "The opposite to left is _________."). A card with the word "answer" follows half of the statement-cards. Participants are instructed to say out loud the missing word when they are presented with the "answer"-card or to just think about the missing word when the card is not presented. After the task, participants complete a recognition sheet with 24 items (8 are new words) and asked to identify the words that have been *said*, *thought* or that are *new*. The task has two versions and the order of the "answer"-cards is reversed across these.

Several scores are derived from the task a) *recognition score* — total of words correctly recalled, b) *discrimination index* — words correctly attributed as either said or thought divided by the total number of previously presented words correctly recalled (hence taking into account overall memory performance), c) *think-report-say errors* — words that were thought and reported as said divided by the number of previously presented words, and d) *say-report-think errors* — words that were said but were reported as thought divided by the number of previously presented words.

2.2.4. Immediate auditory recall

Immediate auditory recall was measured with the digit-span test (DST). During the task, a voice reads out a sequence of random numbers (e.g. 3, 7, 9). Immediately afterwards, the participant has to type the sequence using a keypad. We used a forward (digits must be entered by the order presented) and a backward block (digits are entered in reverse order). Each block consisted of fifteen trials plus practice trials.

2.3. Procedure

All participants were seen on two different days to minimize 'carry-over' effects. Most sessions took place at the participants' homes and the interval between them was never more than one week. Participants in the clinical group were interviewed with PANSS and comparisons screened with the Psychosis Screening Questionnaire (Bebbington and Nayani, 1995) and both were tested with the QT. Participants were then interviewed with the salient and non-salient interviews in a randomly counter-balanced order across the two sessions. Each interview followed a scripted protocol and lasted approximately 15-min.

All interviews were gently interrupted midway for the iSM to be completed. Each participant completed the two versions of the task across the two sessions in a counter-balanced order and the two versions were randomly assigned. After the interviews, participants were asked to score the PANAS and complete the DST. The speech samples were recorded with a digital recorder, transcribed and later coded with the TLC.

2.4. Data analysis

Statistical analyses were carried out on SPSS (IBM, 2012). *t*-Tests and χ^2 were used to characterize and compare the groups on demographic, cognitive and affective variables. ANOVAs were used to compare different variables between groups and across conditions. We used bivariate correlations and linear regressions to explore relationships between the different variables. In order to test mediation, we ran hierarchical regressions to test: 1) if the relationship between negative affect and thought disorder was mediated by performance on internal source monitoring task on the two conditions, separately; and, 2) If the relationship between *change* scores in negative affect between conditions and *change* scores in thought disorder between conditions was mediated by the *change* scores in internal source monitoring between conditions.

3. Results

3.1. Demographic and clinical variables

Table 1 shows demographic, cognitive and clinical measures. The groups did not differ for gender, age or ethnicity. Our comparison group had more years of education and higher scores on the QT.

3.2. Key study variables

PS and AS independently coded 10% (22) of the speech samples for reliability (AS was blind to the study's hypotheses). Kappa values were substantial with tangentiality achieving the highest level of agreement ($K = .82$) and self-reference the lowest ($K = .62$). Because some items of the TLC are dependent on word-count (e.g. poverty of speech), we did not adjust TD for verbosity.

As there was a) no association between positive affect and TD (see Table 3) and b) previous research has indicated that positive affect is not related to TD (Cohen and Docherty, 2005), only the negative scale was analyzed.

When we ran a 2 × 2 ANOVA using NA scores as the dependent variable, the main effect for interview, $F[1,108] = 122.1$, $p < .001$, $\eta_p^2 = .531$, and the group effect were significant, $F[1,108] = 24.44$, $p < .001$, $\eta_p^2 = .185$, with the clinical group reporting more NA than comparisons. The interaction was also significant, $F[1,108] = 8.56$, $p = .004$, $\eta_p^2 = .073$, as the increase in NA across interviews was greater in the clinical group.

A 2 × 2 ANOVA on the TD scores revealed a main effect for interview, $F[1,108] = 38.33$, $p < .001$, $\eta_p^2 = .262$, and for group, $F[1,108] = 28.93$, $p < .001$, $\eta_p^2 = .211$, but the interaction was not significant, $F[1,108] = 3.88$, $p = .052$, $\eta_p^2 = .035$. Both patients and comparisons demonstrated affective reactivity of speech respectively, $t(79) = -6.91$, $p < .001$ and $t(29) = -4.99$, $p < .001$.

When we compared performance across groups and interviews, using the iSM discrimination index as the dependent variable (as recommended in the literature, Docherty, 2012; Harvey, 1985) the main effects for condition, $F[1,108] = 13.36$, $p < .001$, $\eta_p^2 = .110$ and group were significant, $F[1,108] = 22.43$, $p < .001$, $\eta_p^2 = .172$, as was the interaction, $F[1,108] = 8.74$, $p = .004$, $\eta_p^2 = .075$, with the clinical group showing a greater deterioration in the salient interview. Patients but not comparisons had a poorer discrimination index in the salient interview, $t(79) = 5.86$, $p < .001$ and, $t(29) = .556$, $p = .582$, respectively.

In the case of forward DST, the group effect was significant, $F[1,108] = 19.53$, $p < .001$, $\eta_p^2 = .153$, but the effect for condition, $F[1,108] = .107$, $p = .744$, $\eta_p^2 = .001$ and the interaction were not, $F[1,108] = .107$, $p = .744$, $\eta_p^2 = .001$. With DST backwards as the dependent variable, there was also an effect for group, $F[1,108] = 21.3$, $p < .001$, $\eta_p^2 = .165$ but again not for condition, $F[1,108] = 3.32$, $p = .071$, $\eta_p^2 = .03$ or for the interaction, $F[1,108] = .068$, $p = .795$, $\eta_p^2 = .001$.

3.3. iSM and affective reactivity in patients

Table 3 shows bivariate correlations for the patients between affect, TD and iSM indices in the two conditions. In the neutral interview, TD scores correlated with two of the iSM measures (the discrimination index and think-report-say errors) and with NA. In the salient interview, TD correlated with all iSM scores and again with NA.

We ran hierarchical linear regressions on TD scores for both conditions separately, with NA and order of presentation of the conditions entered first and then discrimination scores entered in a second stage. For the neutral condition, NA predicted TD, $F[2,77] = 4.47$, $p = .015$, $\beta = .32$, p = .004. Adding discrimination scores led to an improved model, $F[3,76] = 14.20$, $p < .001$, with the effect for NA no longer significant, $\beta = .16$, $p = .101$, but with the discrimination index as a significant predictor, $\beta = -.54$, $p < .001$.

For the salient condition, the initial model was again significant, $F[2,77] = 5.53$, $p = .006$, with NA predicting TD, $\beta = .35$, $p = .002$. Adding the discrimination index improved the model, $F[3,76] = 16.05$, $p < .001$; the significance of NA was reduced, $\beta = .22$, $p = .024$ and the discrimination index was a significant predictor of TD, $\beta = -.53$, $p < .001$.

Finally, in order to test whether *change* in discrimination indices across interviews was a significant predictor of affective reactivity of speech, we calculated difference scores for NA, the discrimination index and TD by subtracting scores from the neutral from those of the salient condition. In a hierarchical linear regression with affective reactivity of speech as the dependent variable, we entered order of presentation, adding affect change in the second step and then the change in discrimination index in the third (see Table 4). In this analysis, the initial association between the increase in NA and the increase in TD was not significant. However, the change in iSM was a significant predictor of the increase in TD when it was added to the model.

When the mediation analyses were re-run using overall recognition memory scores rather than discrimination scores, very similar results were obtained.

4. Discussion

Replicating previous findings, we found that psychotic patients display more TD when discussing emotionally salient topics and, consistent with results from Tai et al. (2004), we also found the less marked affective reactivity of speech in healthy comparisons, suggesting that it occurs on a continuum with healthy functioning. Secondly, and consistent with previous studies, we found that patients performed considerably worse on the iSM task (Harvey, 1985). In both conditions, nearly all of the scores on this task (with the exception of *say-report-think errors* in the neutral interview) were substantially associated with TD.

The novel aspect of this research concerned the role of the emotional and cognitive variables in the affective reactivity effect. Our clinical group reported more NA during the interviews (especially the salient interview), which is consistent with the literature on emotional experience in schizophrenia (Cohen and Minor, 2010). Although performance on the DST was not affected by condition, the discrimination indices on

Table 3
Bivariate correlations between TD, iSM and affective scores for the clinical group.

	1.	2.	3.	4.	5.	6.	7.	1.	2.	3.	4.	5.	6.	7.
Neutral														
1. TD	–													
2. Recognition score	−.684***	–												
3. Discrimination index	−.561***	.805***	–											
4. Say-report-think errors	.202	−.353***	−.370***	–										
5. Think-report-say errors	.465***	−.497***	−.364***	−.212	–									
6. Positive affect	−.029	.081	.019	.098	−.143	–								
7. Negative affect	.314**	−.299**	−.300**	.023	.258*	−.214	–							
Salient														
1. TD	.831***	−.544***	−.435***	.183	.403***	.036	.291**	–						
2. Recognition score	−.718***	.697***	.590***	−.126	−.471***	−.046	−.290**	−.709***	–					
3. Discrimination index	−.523***	.482***	.457***	−.147	−.359***	−.132	−.205	−.583***	.816***	–				
4. Say-report-think errors	.321**	−.194	−.241*	.183	.099	.215	.044	.303**	−.369***	−.303**	–			
5. Think-report-say errors	.452***	−.622***	−.361***	.062	.465***	−.024	.125	.429***	−.658***	−.604***	−.021	–		
6. Positive affect	−.041	.120	.051	.005	−.120	.597***	−.114	.024	.027	−.135	−.042	.014	–	
7. Negative affect	.290**	−.199	−.142	−.112	.174	.062	.516***	.352***	−.359***	−.244*	.298**	.097	.022	–

* $p < .05$.
** $p < .01$.
*** $p < .001$.

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Table 4
Analysis of mediation, negative affect (x) on thought disorder (y) through discrimination index (m) for the clinical group.

	B	Standard error	Beta	*t*	*p*-Value	95% CI	
1. Dependent variable: Δ thought disorder							
Order of condition	1.166	1.212	.108	.962	.339	−1.247	3.580
2. Dependent variable: Δ thought disorder							
Order of condition	.672	1.235	.062	.544	.588	−1.787	3.132
Δ negative affect	.155	.093	.190	1.661	.101	−.031	.340
3. Dependent variable: Δ thought disorder							
Order of condition	.224	1.202	.021	.187	.852	−2.170	2.619
Δ negative affect	.119	.091	.147	1.313	.193	−.062	.300
Δ discrimination index	−.609	.231	−.290	−2.635	.010	−1.069	−.149

the iSM were, but the effect was only observed in patients. This observation provided preliminary evidence that iSM was implicated in the increased TD seen in the emotionally salient condition.

Our regression analyses showed that, in the patients and in each interview, the relationship between NA and TD was mediated by deterioration in iSM. However, our final analysis based on change scores was less clear-cut. On the one hand, the observed decrements in iSM predicted the increase in TD as expected, supporting the meditational hypothesis. However, the expected association between increased NA and increased TD was not significant. Although this observation might be thought to cast doubt about the chain of processes from negative emotion through impaired source monitoring to TD, it is worth noting that the use of change scores may have introduced additional noise into the data set. Another possibility is that our measure of affect did not sufficiently pick out the specific emotional response that leads to increased TD. Overall, given the evidence that iSM mediated between NA and TD in each condition and that impairment in iSM predicted the increase in TD, we tentatively conclude that the data supports the hypothesis that impaired iSM plays a role in the affective reactivity effect. However, it is important to acknowledge important limitations in the use of meditational analyses (*see* Bullock et al., 2010). One possibility to test mediation further may be to consider experimental manipulations of the mediator (i.e. internal source monitoring) as suggested by Bullock et al. (2010) but this may be difficult to achieve experimentally.

Consistent with previous findings (Nienow and Docherty, 2004, 2005) think-report-say errors were significantly associated with TD whereas say-report-think errors were significantly associated with TD only in the salient interview. A difficulty discriminating between inner speech and speech that is socially-directed is likely to compromise communication by either leading to the omission of segments of speech or by the inadvertent verbalization of inner speech. The former phenomenon would deprive the listener of crucial information for shared understanding. The latter would, for the listener, involve listening to the patient's stream of consciousness, in which case the jumbled up quality of TD could be construed as the condensed nature of inner speech (Vygotsky, 1987).

There are several limitations to this study. The patients and controls were not matched on education or IQ. Also, our interview protocol was different from an everyday conversation. It would be interesting to use more naturalistic speech samples e.g. everyday family conversations; which could facilitate investigation of the impact on TD of those aspects of family communication that have been previously reported to be important in TD (De Sousa et al., 2013).

In future research it could be informative to assesses increases in cortisol secretion as well as explore the role of other variables such as ToM which have been implicated in conversational alignment (Pickering and Garrod, 2006). Finally, therapeutic techniques such as role-playing, five-sentence rule, or relaxation breaks have been suggested to address TD (Beck et al., 2009). An alternative approach would be to develop interventions that specifically target the mechanisms identified in this study. In the case of NA, we subscribe to the suggestion that the therapeutic focus should be on emotion regulation techniques (Beck et al., 2009). Future research should consider the utility of cognitive rehabilitation techniques to improve iSM.

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Contributors

First author (PS) was responsible for data collection and along with AS coded the transcripts. PS and RPB were responsible for carrying out data analyses. PS, RPB and WS wrote the final manuscript. All authors have approved the final manuscript.

Conflict of interest

The authors have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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References

Ammons, R.B., Ammons, C.H., 1962. The quick test (QT): provisional manual. Psychol. Rep. 11, 111–162.

Andreasen, N.C., 1979. Thought, language, and communication disorders: I. Clinical assessment, definition of terms, and evaluation of their reliability. Arch. Gen. Psychiatry 36 (12), 1315.

Andreasen, N.C., 1986. Scale for the assessment of thought, language, and communication (TLC). Schizophr. Bull. 12 (3), 473–482 (Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3764363).

Bearden, C.E., Wu, K.N., Caplan, R., Cannon, T.D., 2011. Thought disorder and communication deviance as predictors of outcome in youth at clinical high risk for psychosis. J. Am. Acad. Child Adolesc. Psychiatry 50, 669–680. http://dx.doi.org/10.1016/j.jaac.2011.03.021.

Bebbington, P.E., Nayani, T., 1995. The psychosis screening questionnaire. Int. J. Methods Psychiatr. Res. 5 (1), 11–19.

Beck, A., Rector, N., Stolar, N., Grant, P., 2009. Schizophrenia: cognitive theory, research and therapy. Psychiatr. Rehabil. J. 32 (4), 327–328.

Bowie, C.R., Harvey, P., 2008. Communication abnormalities predict functional outcomes in chronic schizophrenia: differential associations with social and adaptive functions. Schizophr. Res. 103, 240–247. http://dx.doi.org/10.1016/j.schres.2008.05.006.

Brookwell, M.L., Bentall, R.P., Varese, F., 2013. Externalizing biases and hallucinations in source-monitoring, self-monitoring and signal detection studies: a meta-analytic review. Psychol. Med. 1–11.

Bullock, J.G., Green, D.P., Ha, S.E., 2010. Yes, but what's the mechanism? (don't expect an easy answer). J. Pers. Soc. Psychol. 98, 550–558. http://dx.doi.org/10.1037/a0018933.

Cohen, A., Docherty, N., 2005. Effects of positive affect on speech disorder in schizophrenia. J. Nerv. Ment. Dis. 193 (12), 839–842 (Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16319708).

Cohen, A.S., Minor, K.S., 2010. Emotional experience in patients with schizophrenia revisited: Meta-analysis of laboratory studies. Schizophr. Bull. 36, 143–150. http://dx.doi.org/10.1093/schbul/sbn061.

De Sousa, P., Varese, F., Sellwood, W., Bentall, R.P., 2013. Parental communication and psychosis: a meta-analysis. Schizophr. Bull. http://dx.doi.org/10.1093/schbul/sbt088.

Docherty, N., 1996. Affective reactivity of symptoms as a process discriminator in schizophrenia. J. Nerv. Ment. Dis. 184 (9), 535–541.

Docherty, N., 2012. Missing referents, psychotic symptoms, and discriminating the internal from the externalized. J. Abnorm. Psychol. 121 (2), 416–423. http://dx.doi.org/10.1037/a0026348.

Docherty, N., Evans, I.M., Sledge, W.H., Seibyl, J.P., Krystal, J.H., 1994a. Affective reactivity of language in schizophrenia. J. Nerv. Ment. Dis. 182 (2), 98–102 (Retrieved from <Go to ISI>://A1994MX08500006).

Docherty, N., Sledge, W.H., Wexler, B.E., 1994b. Affective reactivity of language in stable schizophrenic outpatients and their parents. J. Nerv. Ment. Dis. 182 (6), 313–318 (Retrieved from <Go to ISI>://A1994NR37300001).

Haddock, G., Wolfenden, M., Lowens, I., Tarrier, N., Bentall, R.P., 1995. Effect of emotional salience on thought disorder in patients with schizophrenia. Br. J. Psychiatry 167 (5), 618–620 (Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8564317).

Hardy-Baylé, M.-C., Sarfati, Y., Passerieux, C., 2003. The cognitive basis of disorganization symptomatology in schizophrenia and its clinical correlates. Schizophr. Bull. 29 (3), 459–471.

Harvey, P., 1985. Reality monitoring in mania and schizophrenia: the association of thought disorder and performance. J. Nerv. Ment. Dis. 173 (2), 67–73.

Harvey, P., Earleboyer, E.A., Levinson, J.C., 1988. Cognitive deficits and thought-disorder — a retest study. Schizophr. Bull. 14 (1), 57–66 (Retrieved from <Go to ISI>://A1988N190000006).

Harvey, P., Serper, M., 1990. Linguistic and cognitive failures in schizophrenia — a multivariate-analysis. J. Nerv. Ment. Dis. 178 (8), 487–494. http://dx.doi.org/10.1097/00005053-199017880-00003.

IBM, 2012. IBM SPSS Statistics for Macintosh. IBM Corp, Armonk, NY.

Johnson, M.K., Hashtroudi, S., Lindsay, D.S., 1993. Source monitoring. Psychol. Bull. http://dx.doi.org/10.1037/0033-2909.114.1.3.

Kay, S.R., Fiszbein, A., Opler, L.A., 1987. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr. Bull. 13 (2), 261–276 (Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3616518).

Marengo, J., Harrow, M., 1987. Schizophrenic thought disorder at follow-up. A persistent or episodic course? Arch. Gen. Psychiatry 44, 651–659. http://dx.doi.org/10.1001/archpsyc.1987.01800190071011.

Marengo, J., Harrow, M., 1997. Longitudinal courses of thought disorder in schizophrenia and schizoaffective disorder. Schizophr. Bull. 23, 273–285.

Nienow, T., Docherty, N., 2004. Internal source monitoring and thought disorder in schizophrenia. J. Nerv. Ment. Dis. 192 (10), 696–700 (Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15457113).

Nienow, T., Docherty, N., 2005. Internal source monitoring and communication disturbance in patients with schizophrenia. Psychol. Med. 35 (12), 1717–1726. http://dx.doi.org/10.1017/S0033291705005660.

Pickering, M.J., Garrod, S., 2006. Alignment as the basis for successful communication. Res. Lang. Comput. 4, 203–228. http://dx.doi.org/10.1007/s11168-006-9004-0.

Pomarol-Clotet, E., Oh, T., Laws, K.R., McKenna, P.J., 2008. Semantic priming in schizophrenia: systematic review and meta-analysis. Br. J. Psychiatry 192 (2), 92–97.

Racenstein, J.M., Penn, D., Harrow, M., Schleser, R., 1999. Thought disorder and psychosocial functioning in schizophrenia: the concurrent and predictive relationships. J. Nerv. Ment. Dis. 187, 281–289. http://dx.doi.org/10.1097/00005053-199905000-00003.

Spitzer, M., 1997. A cognitive neuroscience view of schizophrenic thought disorder. Schizophr. Bull. 23 (1), 29.

Sprong, M., Schothorst, P., Vos, E., Hox, J., van Engeland, H., 2007. Theory of mind in schizophrenia: meta-analysis. Br. J. Psychiatry J. Ment. Sci. 191, 5–13. http://dx.doi.org/10.1192/bjp.bp.107.035899.

St-Hilaire, A., Docherty, N., 2005. Language reactivity and work functioning in schizophrenia. Schizophr. Res. 75 (2–3), 241–246. http://dx.doi.org/10.1016/j.schres.2004.12.003.

Tai, S., Haddock, G., Bentall, R., 2004. The effects of emotional salience on thought disorder in patients with bipolar affective disorder. Psychol. Med. 34 (5), 803–809 (Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15500301).

Tan, E.J., Thomas, N., Rossell, S.L., 2014. Speech disturbances and quality of life in schizophrenia: differential impacts on functioning and life satisfaction. Compr. Psychiatry 55, 693–698. http://dx.doi.org/10.1016/j.comppsych.2013.10.016.

Vygotsky, L.S., 1987. Thinking and speech. The Collected Works of L. S. Vygotsky. Plenum, New York, NY (Original work published 1934).

Watson, D., Clark, L.A., Tellegen, A., 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. J. Pers. Soc. Psychol. 54, 1063–1070. http://dx.doi.org/10.1037/0022-3514.54.6.1063.

Wilcox, J.A., 1990. Thought disorder and relapse in schizophrenia. Psychopathology 23, 153–156. http://dx.doi.org/10.1159/000284652.

Woods, S.W., 2003. Chlorpromazine equivalent doses for the newer atypical antipsychotics. J. Clin. Psychiatry 64, 663–667. http://dx.doi.org/10.4088/JCP.v64n0607.

World Health Organization, 2004. International Statistical Classification of Diseases and Health Related Problems (ICD-10). World Healh Organization, Geneva.