Psychiatry Research 210 (2013) 896–900

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Investigating affective prosody in psychosis: A study using the Comprehensive Affective Testing System

Susan L. Rossell[a,b,c,d,*], Tamsyn E. Van Rheenen[a,b], Christopher Groot[b,c], Andrea Gogos[c,d], Alison O'Regan[d], Nicole R. Joshua[c,d]

[a] Brain and Psychological Sciences Research Centre, Faculty of Life and Social Sciences, Swinburne University, Melbourne, Australia
[b] Cognitive Neuropsychology Laboratory, Monash Alfred Psychiatry research centre (MAPrc), The Alfred Hospital, Melbourne, Australia
[c] The University of Melbourne, Parkville, Victoria 3010, Australia
[d] Mental Health Research Institute of Victoria, Victoria 3053, Australia

ARTICLE INFO

Article history:
Received 17 September 2012
Received in revised form
26 July 2013
Accepted 27 July 2013

Keywords:
Affective prosody
Schizophrenia
Bipolar disorder
Language and communication

ABSTRACT

Affective prosody is substantially impaired in schizophrenia, yet little is known about affective prosody in bipolar disorder (BD). The aim of this study was to examine affective prosody performance in schizophrenia, schizoaffective disorder and BD on a newly released standardised assessment to further our understanding of BD performance. Fifty-four schizophrenia, 11 schizoaffective and 43 BD patients were compared with 112 healthy controls (HC) on four affective prosody subtests of the Comprehensive Affective Testing System (CATS). Schizophrenia patients showed a 10% reduction in accuracy on two subtests compared to HC. BD showed a trend for performance intermediary to schizophrenia and HC; and schizoaffective patients performed more like HC on these four affective prosody measures. Severity of current auditory hallucination, across all patients, was related to task performance on three of the measures. These data confirm that schizophrenia and BD have reduced affective prosody performance, with deficits in BD being less pronounced than schizophrenia. The schizoaffective results in this study should be interpreted with caution due to small sample size.

1. Introduction

Dysfunction of language and communication is omnipresent in schizophrenia. Recent literature supports the conception of language as a core higher-order cognitive dysfunction in the disorder (e.g., Mitchell and Crow, 2005; Rossell, 2006; Rossell and David, 2006). This language dysfunction is well represented in the DSM-IV diagnostic criteria for schizophrenia, with characteristic cardinal linguistic and communicative symptoms including the following: (1) positive symptoms such as disorganized speech, and (2) negative symptoms such as affective flattening in communication, or more commonly referred to as difficulties with affective prosody[1] (i.e., dysfunctional receptive affective prosody, that is, processing emotional meaning from pitch and melody alterations in speech, and expressive affective prosody, that is, communicating emotional meaning through using pitch and melody alterations during speech). Patients with auditory hallucinations in schizophrenia have poorer affective prosody performance when compared with schizophrenia patients with either no history of hallucinations (Rossell and Boundy, 2005), or no current hallucinations (Shea et al., 2007). The authors of this work suggest that difficulties perceiving prosodic features of speech (i.e. pitch and intonation) needed to accurately distinguish affective prosody that may contribute to the misattribution of speech events in persons with auditory hallucinations.

In contrast, both expressive and receptive prosody, has been poorly investigated in bipolar disorder (BD) (see Van Rheenen and Rossell (2013) for a review). There is growing evidence of mood influenced social cognitive impairments in BD (Langenecker et al., 2010; Venn et al., 2004). Examination of the impact of affective prosody in BD is important given the similarity of symptoms it shares with schizophrenia. To date, the authors are aware of only a handful of studies that have investigated receptive prosody in BD. Results are varied with findings from Bozikas et al. (2007), Hofer et al. (2010) and Murphy and Cutting (1990) demonstrating impaired processing of affective prosody in BD; and findings from

* Corresponding author at: Cognitive Neuropsychology Lab, Monash Alfred Psychiatry research centre (MAPrc), The Alfred Hospital, Burwood Road Hawthorn Melbourne, VIC 3004 Australia. Tel.: +61 414 493784.
E-mail address: srossell@srossell.com (S.L. Rossell).

[1] Affective prosody, that is, using prosodic elements (rhythm, stress or intonation) in speech to convey or express emotions, is distinguished from other types of prosody for example, semantic or linguistic prosody, which convey the form of utterance, that is not encoded by grammar or vocabulary choice.

0165-1781/$ - see front matter © 2013 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.psychres.2013.07.037

Edwards et al. (2001), Mitchell et al. (2004) and Vederman et al., (2012) finding affective prosody processing is intact. Further research is clearly needed.

Taken together, convincing evidence exists for a pervasiveness dysfunction of affective prosody in schizophrenia. In BD, understanding of prosody ability is less clear. One of the problems for this literature is the lack of universal assessment for affective prosody. Many reports have used experimental measures that have not been validated or examined for sensitivity. The Comprehensive Affective Testing System (CATS: Froming et al., 2006) is a recently constructed battery of both visual and auditory affective tasks that provide a standardised assessment. The affective prosody tasks use six emotions (happy, sad, angry, surprise, fear and disgust) and a neutral emotional state. The subtests are designed to test emotion matching with and without verbal denotation, emotional tone or prosodic processing with and without verbal denotation, and with conflicting or congruent semantic content. A male actor speaks on these prosodic subtests and the voice is digitized to maximize the quality of the sound. To date, the CATS has not been used to investigate affective prosody in schizophrenia or BD. In addition, schizoaffective disorder patients have usually been either included within a schizophrenia group or alternatively excluded due to mood episodes in other social cognitive research. Given its phenotypic overlap with both disorders we have investigated affective prosody performance in a separate group of schizoaffective disorder patients.

The current study examined the performance of schizophrenia, schizoaffective and BD patients in comparison to healthy controls on the four major affective prosody subtests of the CATS. Our primary aim was to examine the performance profile of BD patients in relation to schizophrenia and schizoaffective disorder to confirm whether deficits in BD are present. Based on previous literature it was predicted that patients with schizophrenia and schizoaffective disorder would be impaired on the four subtests compared to healthy controls, whilst BD would show intermediary performance. Our secondary aim was to confirm whether severity of auditory hallucinations was associated with affective prosody task performance. Affective prosody performance in the patients was predicted to correlate with auditory hallucinations (AH). Lastly, we aimed to investigate whether affective prosody performance was related to any further clinical variables. Performance was predicted to correlate with current severity of mood symptoms, both depression and mania.

2. Methods

2.1. Participants

The current study included 54 patients with schizophrenia, 11 patients with schizoaffective disorder and 43 patients with BD-I. Patients were recruited via community support groups and community care units and were all out-patients. Diagnosis was ascertained using the Structured Clinical Interview for DSM-IV (SCID: First et al., 1996). Current symptomology was acquired using the Positive and Negative Syndrome Scale (PANSS: Kay et al., 1987). AH were scored using item P3 on the PANSS and only rating AH. Ratings of depression and mania were made using the Beck Depression Inventory (BDI: Beck and Steer, 1987 with BDI > 13 being depressed) and the Bech-Rafaelsen Mania Rating Scale (MRS: Bech et al., 1979 with MRS > 8 being hypomanic), respectively. In the BD group, seventeen were euthymic and twenty-six depressed. Only patients with no other co-morbid Axis 1 diagnoses were included in the study. Demographic and clinical characteristics are presented in Table 1.

Within the schizophrenia group, all fifty-four were taking antipsychotic medication, five were also taking mood stabilizers, and eight were also taking antidepressants. Of the schizoaffective group, eleven were taking antipsychotic medication, eleven were taking mood stabilizers, and two were taking antidepressants. Of the BD patients, twenty were taking antipsychotic medication, thirty were taking mood stabilizers, ten were taking antidepressants and three participants were medication free.

One hundred and twelve healthy control participants were recruited via newspaper advertisements. Control participants were excluded if they had any history of psychiatric disorder or a first degree relative with either schizophrenia or BD (SCID: First et al., 1996). Participants from all four groups met the following criteria: (a) no history of neurological disorder or head trauma, (b) no current substance abuse or dependence (previous year), (c) English as first language, (d) between the ages of 18–65 years and (e) predicted IQ >85 as scored by the National Adult Reading Test (NART: Nelson and Willison, 1991).

The study was carried out in accordance with the Declaration of Helsinki. The study had ethical approval from North Western Mental Health, Melbourne Victoria. Informed consent of all the participants was obtained after the study had been fully explained.

2.2. Tasks

2.2.1. Comprehensive Affective Testing System

Participants were tested with four of the 13 subtests from the Comprehensive Affective Testing System (CATS: Froming et al., 2006). The subtests are designed to test emotional tone or prosodic processing with and without verbal denotation, and with conflicting or congruent semantic content, taking approximately 20 min to complete. None of the subtests have practice items. Subtest order was counterbalanced. For each subtest overall accuracy and reaction time (RT) to both correct and incorrect answers was recorded. The four subtests are as follows:

(1) The emotional prosody discrimination (EPD) subtest includes pairs of non-affective sentences ($N=22$) read by the actor exhibiting happiness, sadness, anger, fright or neutrality in his voice. Participants indicate whether the sentence pairs reflect the same or different emotions.
(2) In the name emotional prosody subtest (NEP), one sentence ($N=22$) is read at a time by the actor. Participants select which emotion (happiness, sadness, anger, fright or neutrality) they believe the actor's voice expresses.
(3) During the conflicting prosody-attend to prosody subtest (CPP), participants are instructed to ignore the emotional meaning represented in the sentence ($N=32$) and focus on the emotional tone expressed by the voice.
(4) In reverse, during the conflicting prosody-attend to meaning subtest (CPM), the same sentences ($N=32$) are presented as in the previous subtest, however, participants are now asked to ignore the emotional tone expressed by the voice and focus on the emotional meaning represented in the sentence.

2.3. Statistical analysis

Demographic and clinical group differences were assessed via one-way between-groups analysis of variance (ANOVA) or Chi-Square tests. Task-related group differences were assessed via one-way between-groups ANOVA with Scheffe post-hoc tests. Due to group differences in the proportion of males and females across the groups, the ANOVAs were re-run with gender as a fixed factor. In addition, given that the BD group had euthymic and depressed members the ANOVAs were re-run with mood state (depressed, euthymic and hypomanic) as a fixed factor. Neither of the factors was significant for any of the prosody measures, and for brevity will not be presented. Given group differences in age and levels of education, a two-fold validity check was performed to examine the effects of these demographic variables; first, by using Pearson's product moment correlations between age, education and the eight affective prosody variables. Even using a stringent alpha of .01, the majority of variables were significantly correlated with age and education. Therefore, the eight ANOVA's were re-run with age and education as covariates; these are presented in Table 3. Relationships between task performance and the clinical characteristics from the PANSS, MRS and BDI were investigated using Pearson's product moment correlations (Table 4) (using $p<.01$), and with P3 (AH only) from the PANSS to investigate AH associations.

3. Results

3.1. Demographics

As can be seen in Table 1, the schizophrenia patients were significantly less educated and older than controls. Positive symptom ratings did not differ between the schizophrenia and schizoaffective groups, but these ratings were significantly higher than BD. There were no group differences on negative symptom ratings, mania or depression; and no differences between patient groups on age or years of illness onset.

3.2. Group comparisons

Table 2 displays the mean accuracy and RT data for the four subtests across the four groups. Table 3 shows the same group

Table 1
Demographic and clinical characteristics of the four participant groups (mean (standard deviation) unless otherwise stated).

Group	Healthy Control	Schizophrenia	Schizoaffective	Bipolar	Group comparisons
N	112	54	11	43	
Age	35.3 (12.4)	42.2 (10.5)	43.6 (13.5)	40.5 (10.6)	F=5.7 p=.001 $C<SZ$
M/F	37/75	35/19	4/7	16/27	Chi=15.8 $p<.001$
Years in education	16.8 (3.2)	14.0 (3.5)	14.5 (2.7)	14.7 (3.6)	F=10.4 p=.001 $C>SZ$
Age of onset	–	23.5 (7.2)	20.5 (7.0)	21.4 (7.0)	F=1.4 NS
Years illness	–	18.8 (10.3)	23.2 (12.8)	19.1 (10.1)	F=.8 NS
Total *P*	–	14.5 (6.1)	14.5 (5.5)	10.8 (3.5)[**]	
Total *N*	–	11.2 (4.4)	10.2 (3.2)	9.2 (2.9)	
Total *G*	–	24.3 (6.6)	26.1 (6.4)	24.3 (6.6)	
MRS	–	2.0 (2.6)[a]	3.5 (3.6)	1.9 (2.1)	
BDI	–	15.9 (13.9)[a]	13.4 (9.7)	18.4 (12.1)	

M/F=Male/Female, Total P=Positive subscale from PANSS, Total N=Negative subscale from PANSS, Total G=Total general from PANSS, MRS=Bech-Rafaelsen Mania Rating Scale, BDI=Beck Depression Inventory.

[**] $p<.001$ Group difference between schizophrenia and bipolar disorder.
[a] N=48.

Table 2
Mean (standard deviation) for accuracy and reaction time data for the four CATS subtests.

	Control	Schizophrenia	Schizoaffective	Bipolar	Group comparisons[a]
EPD % cor	96.8 (4.2)	96.2 (4.4)	98.3 (3.1)	95.5 (5.5)	$F(3,216)=1.5$, $p=.22$
EPD rt cor	6.1 (.83)	6.9 (1.1)	6.7 (.9)	6.5 (1.0)	$F(3,216)=9.0$, $p=.001$, $C<SZ$
NEP % cor	75.3 (11.7)	64.4 (15.8)	72.3 (16.6)	66.8 (16.4)	$F(3,216)=8.9$, $p=.001$, C > SZ and C > BD
NEP rt cor	4.5 (1.2)	4.8 (1.7)	4.6 (1.2)	4.6 (1.3)	$F(3,216)=.6$, $p=.62$
CPP % cor	88.0 (7.9)	79.0 (11.5)	86.4 (10.8)	84.1 (11.8)	$F(3,216)=10.2$, $p=.001$, $C>SZ$
CPP rt cor	4.6 (.9)	5.2 (1.3)	5.0 (.8)	5.2 (1.5)	$F(3,216)=5.5$ $p=.001$ C < SZ and C < BD
CPM % cor	70.1 (7.4)	66.1 (8.2)	69.3 (5.9)	70.2 (7.2)	$F(3,216)=3.7$, $p=.01$, $C>SZ$
CPM rt cor	3.9 (.9)	4.5 (1.2)	4.5 (1)	4.6 (1.7)	$F(3,216)=5.0$, $p=.002$, $C<SZ$ and $C<BD$

EPD – emotional prosody discrimination, NEP – name emotional prosody, CPP – conflicting prosody-attend to prosody, CP – conflicting prosody-attend to meaning, cor – correct, rt – reaction time in seconds, in – incorrect.

[a] One way Anova using student Scheffe comparisons.

Table 3
Group comparisons re-run with age and education as co-variates.

	Age F p	Education F p	Group F p	Group contrasts
EPD % cor	8.2.005	.002 NS	1.4 NS	
EPD rt cor	9.1.003	1.8 NS	4.5.004	$C<SZ$ (p=.001)
NEP % cor	21.9.001	8.6.003	3.3.02	$C>SZ$ (p=.008) $C>BD$ (p=.04)
NEP rt cor	1.8 NS	1.6 NS	.6 NS	
CPP % cor	27.6.001	21.2.001	4.1.007	$C>SZ$ (=.003)
CPP rt cor	14.3.001	.4 NS	3.3.02	$C<SZ$ (p=.01) $C<BD$ (p=.008)
CPM % cor	5.2.02	5.3.02	2.2 NS	
CPM rt cor	7..009	.7 NS	2.4 NS	

comparisons across the subtests with age and education as covariates.

3.3. Accuracy

Accuracy was at near ceiling and not significantly different across groups for the EPD task. In contrast, accuracy was more moderate for the other three subtests with group differences present. In comparison to healthy controls, both schizophrenia and BD patients showed a 10% reduction on the NEP performance, and schizophrenia patients had a 9% reduction on the CPP task. These group differences remained after controlling for age and education. Group differences were more minor on the CPM subtest with schizophrenia patients showing a 4% reduction (this group difference did not remain when controlling for age and education), and the other patient groups showing similar performance to healthy controls.

3.4. Reaction times (RT)

The schizophrenia patients were significantly slower than controls on the EPD but there was no difference between groups for the NEP. The schizophrenia and BD patients were slightly slower than controls on the CPP and CPM. These group differences remained significant for EPD and CPP when controlling for age and education. The RT data should be interpreted with some caution as participants are instructed to try and be as accurate as possible. In addition, the tasks do not automatically continue between trials as each participant's response is used as the indicator for the next trial to start. Some individuals can take a long time to decide upon their answer, which is reflected by the large standard deviations for all the reaction time data.

3.5. Correlations

Table 4 displays the intercorrelations between variables in the study. There were no relationships between mood symptoms and CATS accuracy or RT scores. Reaction time on the CPM task was related to positive symptom ratings. Accuracy on CPP correlated with global positive symptoms and negative symptoms from the

Table 4
Intercorrelations amongst variables across all three clinical groups together ($N = 108$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Total P[1]	1													
Total N[2]	.29*	1												
Total G[3]	.56**	.50**	1											
Mania[4]	.56**	.10	.21	1										
Depression[5]	.30	.18	.40**	.06	1									
P3[6]	.13	.20	.02	.20	.00	1								
EPD % cor[7]	.10	.15	.04	.09	.14	.02	1							
EPD rt cor[8]	.23	.20	.12	.18	.04	.10	.12	1						
NEP % cor[9]	.10	.22	.10	.00	.10	−.31 **	−.22*	.24**	1					
NEP_RT[10]	.05	.10	.10	.11	.04	−.10	.05	.43**	.41**	1				
CPP Correct[11]	.20	.34**	.34**	.06	.10	−.33**	.21*	−.23 **	.62**	.20*	1			
CPP_RT[12]	.14	.06	.06	.20	.06	−.01	−.03	−.63*	−.15	.52**	.10	1		
CPM Correct[13]	.03	.11	.11	.14	.07	−.36**	.20	−.10	.31**	.20*	.40**	.10	1	
CPM_RT[14]	.27*	.12	.12	.23	.10	.14	−.03	.55**	−.25**	.44**	−.17	.69**	.31**	1

EPD – emotional prosody discrimination, NEP – name emotional prosody, CPP – conflicting prosody-attend to prosody, CPM – conflicting prosody-attend to meaning, cor – correct, rt – reaction time in seconds.

* $p < .01$.

** $p < .001$.

PANSS. Accuracy on three of the subscales NEP, CPP and CPM correlated with the AH score from the PANSS (item P3 for AH only) for all patients.

4. Discussion

In agreement with our predictions, schizophrenia patients had reduced affective prosody accuracy. However, this was specific to two of the subtests of the CATS: NEP and CPP. EPD was not impaired and showed similar performance in all groups, whilst CPM showed only a minor performance reduction. In contrast, performance in BD was somewhat surprising with patients performing on par with controls in all but one of the CATS subtests, NEP. In partial support of our hypothesis BD patients showed a trend for an intermediary effect on this subtest, performing worse than controls but better than schizophrenia patients, although the difference between the patient groups was not significant. This intermediate effect is consistent with previous social cognition research where BD performance tends to be impaired in comparison to controls but not as severely as schizophrenia patients (Addington and Addington, 1998; Joshua, 2010).

Unexpectedly, no significant differences were found between the performances of controls and schizoaffective patients, suggesting that schizoaffective patients perform similarly to controls on tasks of prosody. This is in direct contradiction to Edwards et al. (2001), who reported that schizoaffective patients (analyzed with schizophreniform and delusional disorder as a psychotic disorders group) had difficulty recognizing emotional prosody. Thus, our results should be interpreted with caution, as the schizoaffective group was significantly smaller in size than either the control or other patient groups. Given that schizoaffective disorder, schizophrenia and BD share similar phenomenology, and have potentially overlapping genetic aetiologies it is quite likely that this lack of effect is attributable to the sample being underpowered rather than there being no prosodic abnormality. Given the non-effect of this group's performance across all prosody tasks, the following discussion will focus on findings relevant to the schizophrenia and BD groups.

Our results suggest that in comparison to controls, schizophrenia patients are distracted by prosodic intonation when attending to emotional meaning, and have difficulty ignoring the emotion content when making decisions about what emotion is being expressed. Their ability to accurately name spoken emotions was also impaired. Thus, confirming affective prosody deficits across a number of tasks in schizophrenia. No such effect was observed for the BD sample; that is, they appeared to have no difficulty in separating emotion meaning from emotional intonation but did have difficulty identifying emotional expressions. This suggests that difficulty in processing affect in schizophrenia is generalized, affecting processing of emotional prosody across different tasks. In BD however, the deficit appears to be specific to direct identification of emotional prosody. Reasons for the specific deficit on this task are unclear.

With regard to our symptomatology hypotheses, we found that contrary to expectations, mood and overall positive symptoms did not correlate with accuracy or reaction time performance on any of the CATS subtests in either the schizophrenia or BD group (with the exception of accuracy to CPM and positive symptoms). However, in agreement with our previous work we did establish that patients with AH showed reduced affective prosody performance on three of the tasks. The novel finding of this study being that this finding was independent of diagnostic group and present in BD and schizoaffective disorder.

Our results indicate that regardless of mood/psychosis status both patient groups performed slower on the CPM and CPP than controls. Given that these tasks require one to filter out one type of information whilst simultaneously attending to other information, these tasks are arguably more difficult in comparison to the EPD or NEP. This increased difficulty may have placed a greater neurocognitive strain on patients such that compensation was required to enhance the chances of accurate responding. This idea may also go some way in explaining why accuracy results were comparable between controls and BD patients on these tasks, and why a more generalized deficit across most tasks in the schizophrenia patients was evident. It may be that increased severity of neurocognitive impairment in schizophrenia populations contributes poorer overall function (i.e. poor attention and memory for task instructions) over and above the purely emotional prosodic impairment that the less severely affected BD patients tend to show. That is, that the effects of impaired neurocognitive severity in schizophrenia are more widespread (Gogos et al., 2010), and thus they cannot compensate accuracy with longer responses when faced with increased task difficulty as in BD.

In sum, we interpret these results as indicating that prosodic emotional impairments occur independently of mood or psychosis symptomatology, yet emotional prosody performance is affected by the severity of AH symptoms. This is fitting given that there is other evidence to suggest that cognitive performance tends to be worse during phases of psychosis (Albus et al., 1996; Martinez-Aran et al., 2004). Further research examining these effects across

BD phases and in symptom free schizophrenia populations would be useful.

Beyond the limitations previously mentioned, some further points warrant discussion. Firstly, speech recognition is impacted heavily by accents which differ markedly across cultures and are noticeable based on differences in word stress, pitch and duration (Koike et al., 1998). The pronunciation of words in Australian and American accents are quite distinct (Yan et al., 2007). The CATS battery prosody tasks use sentences spoken with an American accent, which may confound the accuracy of responses by increasing the difficulty of the task in an Australian population. The development of a task using sentences spoken with an Australian accent would be useful for increasing the ecological validity of future studies and for examining potential accent confounds if compared with the CATS. Secondly, the sentences used in the CATS battery are spoken by one male actor. Introducing variability in the voices used to produce the sentence would reduce confounds based on individual differences in the expression of emotion and allow for the analysis of gender or voice effects. Finally, the CATS prosody tasks may introduce undue memory load on participants because stimuli are presented only once, and response choices are not visually available for recognition. Including a visual cue which indicates which response choices are available during the auditory presentation of stimuli might be useful to reduce this type of confound.

Nevertheless, we have presented findings of impaired prosodic processing performance in schizophrenia and BD. Identifying affective prosody appears to be the most robust subtest for distinguishing psychiatric patients from controls. Our results suggest that BD and schizophrenia patients are impaired in their ability to name emotions, with schizophrenia patients also having difficulty filtering out emotional meaning or emotional intonation when placed under conditions of conflict.

References

Addington, J., Addington, D., 1998. Facial affect recognition and information processing in schizophrenia and bipolar disorder. Schizophrenia Research 32, 171–181.

Albus, M., Hubmann, W., Wahlheim, C., Sobizack, N., Franz, U., Mohr, F., 1996. Contrasts in neuropsychological test profile between patients with first-eoisode schizophienia and first-episohe affective disorders. Acta Psychiatrica Scandinavica 94, 87–93.

Bech, P., Bolwig, T.G., Kramp, P., Rafaelsen, O.J., 1979. The Bech-Rafaelsen Mania Scale and the Hamilton Depression Scale. Acta Psychiatrica Scandinavica 59, 420–430.

Beck, A.T., Steer, R.A., 1987. The Beck Depression Inventory Manual. The Psychological Corporation, San Antonio.

Bozikas, V.P., Kosmidis, M.H., Tonia, T., Andreou, C., Focas, K., Karavatos, A., 2007. Impaired perception of affective prosody in remitted patients with bipolar disorder. Journal of Neuropsychology & Clinical Neurosciences 19, 436–440.

Edwards, J., Pattison, P.E., Jackson, H.J., Wales, R.J., 2001. Facial affect and affective prosody recognition in first-episode schizophrenia. Schizophrenia Research 48, 235–253.

First, M.B., Spitzer, R.L., Gibbon, M., Williams, J.B., 1996. Structured Clinical Interview for DSM-IV Axis I Disorders, Clinician Version (SCID-CV). American Psychiatric Press, Washington, D.C.

Froming, K., Levy, M., Schaffer, S., Ekman, P., 2006. The Comprehensive Affect Testing System. Psychology Software, Inc., Gainesville, FL.

Gogos, A., Joshua, N., Rossell, S.L., 2010. Using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) to investigate group and gender differences in schizophrenia and bipolar disorder. Australian & New Zealand Journal of Psychiatry 44 (3), 220–229.

Hofer, A., Baumgartner, S., Benecke, C., Biedermann, F., Deisenhammer, E.A., Hausmann, A., et al., 2010. Perception of affective prosody in remitted patients with schizophrenia and bipolar disorder I. Schizophrenia Research 117, 213.

Joshua, N.R., 2010. Face Processing in Schizophrenia: An Investigation of Configural Processing and the Relationship with Facial Emotion Processing and Neurocognition. (Unpublished Ph.D. dissertation).

Kay, S.R., Fiszbein, A., Opler, L.A., 1987. The Positive and Negative Syndrome Scale (PANSS) for schizophrenia. Schizophrenia Bulletin 13, 261–276.

Koike, K., Suzuki, H., & Saito, H., 1998. Prosodic Parameters in Emotional Speech. Paper presented at the 5th International Conference on Spoken Language Processing, Sydney, Australia.

Langenecker, S.A., Saunders, E.F.H., Kade, A.M., Ransom, M.T., McInnis, M.G., 2010. Intermediate: cognitive phenotypes in bipolar disorder. Journal of Affective Disorders 122, 285–293.

Martinez-Aran, A., Vieta, E., Reinares, M., Colom, F., Torrent, C., Sanchez-Moreno, J., et al., 2004. Cognitive function across manic or hypomanic, depressed, and euthymic states in bipolar disorder. American Journal of Psychiatry 161, 262–270.

Mitchell, R.L.C., Crow, T.J., 2005. Right hemisphere language functions and schizophrenia: the forgotten hemisphere? Brain 128, 963–978.

Mitchell, R.L.C., Elliott, R., Barry, M., Cruttenden, A., Woodruff, P.W.R., 2004. Neural response to emotional prosody in schizophrenia and in bipolar affective disorder. British Journal of Psychiatry 184, 223–230.

Murphy, D., Cutting, J., 1990. Prosodic comprehension and expression in schizophrenia. Journal of Neurology, Neurosurgery & Psychiatry 53, 727–730.

Nelson, H.E., Willison, J., 1991. National Adult Reading Test manual, 2nd ed. NFER-Nelson, Windsor.

Rossell, S.L., 2006. Category fluency performance in patients with schizophrenia and bipolar disorder: the influence of affective categories. Schizophrenia Research 82, 135–138.

Rossell, S.L., Boundy, C.L., 2005. Are auditory–verbal hallucinations associated with auditory affective processing deficits? Schizophrenia Research 78, 95–106.

Rossell, S.L., David, A.S., 2006. Are semantic deficits in schizophrenia due to problems with access or storage? Schizophrenia Research 82, 121–134.

Shea, T.L., Sergejew, A.A., Burnham, D., Jones, C., Rossell, S.L., Copolov, D.L., et al., 2007. Emotional prosodic processing in auditory hallucinations. Schizophrenia Research 90, 214–220.

Van Rheenen, T.E., Rossell, S.L., 2013. Is the nonverbal behavioural emotion processing profile of bipolar disorder impaired? A critical review. Acta Psychiatrica Scandinavica , http://dx.doi.org/10.1111/acps.12125.

Vederman, A.C., Weisenbach, S.L., Rapport, L.J., Leon, H.M., Haase, B.D., Franti, L.M., et al., 2012. Modality-specific alterations in the perception of emotional stimuli in bipolar disorder compared to healthy controls and major depressive disorder. Cortex 48 (8), 1027–1034, http://dx.doi.org/10.1016/j.cortex.2011.03.017..

Venn, H.R., Gray, J.M., Montagne, B., Murray, L.K., Burt, M.D., Frigerio, E., et al., 2004. Perception of facial expressions of emotion in bipolar disorder. Bipolar Disorders 6, 286–293.

Yan, Q., Vaseghi, S., Rentzos, D., Ho, C.-H., 2007. Analysis and synthesis of formant spaces of British, Australian, and American accents. IEEE Transactions on Audio, Speech and Language Processing 15, 676–689.