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Affective prosody perception in symptomatically remitted patients with schizophrenia and bipolar disorder

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ABSTRACT

Affect perception has frequently been shown to be impaired in patients suffering from schizophrenia or bipolar disorder (BD), but it remains unclear whether these impairments exist during symptomatic remission and whether the two disorders differ from each other in this regard. Most previous studies have investigated facial affect recognition, but not the ability to decode mental states from emotional tone of voice, i.e. affective prosody perception (APP). Accordingly, the present study directly compared APP in symptomatically remitted patients with schizophrenia or BD and healthy control subjects and investigated its relationship with residual symptomatology in patients.

Patients with schizophrenia and BD showed comparable APP impairments despite being symptomatically remitted. In comparison to healthy control subjects, overall APP deficits were found in BD but not in schizophrenia patients. Both patient groups were particularly impaired in the identification of anger and confounded it with neutral prosody. In addition, schizophrenia patients frequently confused sadness with happiness, anger, or fright. There was an inverse association between the degree of residual positive symptoms and the ability to correctly recognize happiness in schizophrenia patients.

Overall, these data indicate that impairments in APP represent an enduring deficit and a trait marker of both schizophrenia and BD and that the level of impairment is comparable between disorders.

1. Introduction

The ability to accurately recognize, discriminate, and experience emotional stimuli represents a fundamental skill for successful social interaction. A number of studies dealing with affect perception in patients with schizophrenia or bipolar disorder (BD) have demonstrated deficits in this area during both acute phases of the disorders as well as during periods of symptomatic remission (Hofer et al., 2010; Hoertnagl and Hofer, 2014). A shortcoming of most studies is that they have included relatively small patient samples with varied clinical symptoms and that they did not directly compare affect recognition abilities across schizophrenia and BD. To overcome these limitations, we have recently studied facial affect recognition (FAR) abilities in patients meeting strict remission criteria. Compared to healthy control subjects, schizophrenia patients were particularly impaired in the recognition of facial expressions depicting anger, disgust and sadness, while BD patients showed deficits in the recognition of disgusted and happy facial expressions. A comparison of the two patient groups revealed that individuals suffering from BD outperformed those with schizophrenia in the recognition of expressions depicting anger. In addition, we found an inverse association between the degree of residual symptoms of depression and the ability to correctly recognize happy facial expressions in BD patients, whereas no relationship between FAR and residual symptomatology was seen in schizophrenia patients (Yalcin-Siedentopf et al., 2014). Lee et al. (2013), on the other hand, investigated both social (including FAR) and nonsocial cognition in patients suffering from schizophrenia or bipolar disorder and a non-psychiatric control group and found comparable performance patterns in bipolar patients and healthy control subjects, whereas schizophrenia patients showed impairments across both domains compared to both bipolar patients and healthy controls.

So far, the bulk of research in serious mental illness (SMI) investigated FAR but not the ability to decode mental states from emotional tone

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of voice, i.e. affective prosody perception (APP). In a study comparing the two disorders, Vaskinn et al. (2007) reported on auditory emotion identification impairments in male schizophrenia but not BD patients, whereas Rossell et al. (2013) found such deficits among both diagnostic groups with BD patients showing a trend for performance intermediary to schizophrenia patients and healthy individuals. In addition, schizophrenia but not BD patients were impaired in recognizing the vocal emotion while ignoring the affective meaning of test trials.

The sample investigated in our abovementioned study (Yalcin-Siedentopf et al., 2014) also underwent APP assessment, the results of which are the focus of the present report. Contrary to Vaskinn et al. (2007) and Rossell et al. (2013) we included a large sample of individuals who were symptomatically remitted. The primary aim of our study was to investigate impairments in APP as a potential trait marker for SMI. Secondly, we wanted to confirm whether schizophrenia patients have greater APP deficits compared with individuals suffering from BD. Lastly, we aimed to investigate whether APP performance was related to residual symptomatology.

2. Materials and methods

Patients meeting diagnostic criteria for schizophrenia or BD-I and healthy control subjects between the ages of 18 and 60 were included into a cross-sectional study. Patients were recruited from the psychiatric outpatient services of the Medical Universities of Innsbruck and Salzburg, while control subjects were recruited from the community and were chosen to match patients in age, sex, and education. All participants signed informed consent forms in accordance with the local ethics committees.

In patients, diagnoses were confirmed by using the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998). In order to ensure symptomatic remission, schizophrenia patients had to meet the severity component criteria proposed by Andreasen et al. (2005), whereas BD patients had to have a score of 8 or less on both the Montgomery–Asberg Depression Rating Scale (MADRS) (Montgomery and Asberg, 1979) and the Young Mania Rating Scale (YMRS) (Young et al., 1978). Ratings were completed by psychiatrists belonging to a trained research team. Healthy participants had to have a score of 63 or less on the Brief Symptom Inventory (BSI; Franke, 2000) and no history of any psychiatric illness. Exclusion criteria in patients included any other axis I disorder as well as developmental disorders and any physical illness that may have affected the participants' cognitive performance in all three groups (e.g., history of head trauma or epilepsy; history of electroconvulsive therapy in patients).

2.1. Premorbid intelligence

In patients, premorbid intelligence was measured by using the German adaptation of the National Adult Reading Test (Nelson, 1982), the Mehrfachwahl-Wortschatz-Test-B (MWT-B; Lehrl, 1977), a reliable and valid multiple-choice vocabulary test. The items of the MWT-B consist of 37 lines, each comprising five words. One is an authentic word from the dictionary, while four are fictitious. The participant is asked to find the correct word and to underline it. Each correctly recognized word scores one point.

2.2. Affective prosody perception test

APP was assessed by using subtest 8 ("name emotional prosody") of the Comprehensive Affective Testing System (CATS, Froming et al., 2003). In this test, one sentence at a time is read by a male actor and the subject selects which emotion (happiness, sadness, anger, fright or neutrality) the voice expresses. With 22 sentences read, the total score ranges from 0 to 22. In addition, we calculated misidentification scores.

Table 1
Sample characteristics.

Variable	Group		
	Schizophrenia patients N = 41	Bipolar patients N = 58	Controls N = 85
Age, mean ± SD	40.5 ± 8.5	42.2 ± 11.8	39.2 ± 8.6
Gender, N (%)			
Male	22 (53.7%)	20 (34.5%)	42 (49.4%)
Female	19 (46.3%)	38 (65.5%)	43 (50.6%)
Education, years, mean ± SD	12.9 ± 2.9	13.0 ± 2.9	13.3 ± 2.2
MWT-B, percentile, mean ± SD	60.9 ± 24.5	67.9 ± 25.6	
Duration of illness, years, mean ± SD	12.4 ± 6.9	13.7 ± 9.9	–
PANSS positive symptoms, mean ± SD	8.1 ± 1.6	–	–
PANSS negative symptoms, mean ± SD	10.0 ± 3.1	–	–
PANSS general symptoms, mean ± SD	20.2 ± 3.2	–	–
PANSS total score, mean ± SD	38.3 ± 6.5	–	–
MADRS, mean ± SD	–	2.8 ± 2.3	–
YMRS, mean ± SD	–	1.1 ± 1.4	–
GAF score, mean ± SD*	76.0 ± 15.3	81.9 ± 11.5	–
Treatment, N (%)			
MS monotherapy	0 (0.0%)	9 (15.5%)	–
AP monotherapy	26 (63.4%)	0 (0.0%)	–
AP + AP	5 (12.2%)	0 (0.0%)	–
AD monotherapy	0 (0.0%)	0 (0.0%)	–
MS + AP	2 (4.9%)	20 (34.5%)	–
MS + AD	0 (0.0%)	8 (13.8%)	–
AP + AD	6 (14.6%)	3 (5.2%)	–
MS + AP + AD	0 (0.0%)	17 (29.3%)	–
Marital status, N (%)**			
Single	20 (48.8)	26 (44.8)	22 (25.9)
Married/stable partnership	9 (22.0)	17 (29.3)	52 (61.2)
Divorced/separated	11 (26.8)	14 (24.1)	11 (12.9)
Widowed	1 (2.4)	1 (1.7)	0 (0.0)
Housing, N (%)**, ***			
With original family	4 (9.8)	6 (10.3)	1 (1.2)
With own family	7 (17.1)	27 (46.6)	73 (85.9)
Alone	25 (61.0)	23 (39.7)	10 (11.8)
In a small group home	2 (4.9)	0 (0.0)	0 (0.0)
Other	3 (7.3)	2 (3.4)	1 (1.2)
Employment status, N (%)**			
Full-time employment	6 (14.6)	13 (22.4)	58 (68.2)
Part-time employment	6 (14.6)	11 (19.0)	18 (21.2)
Supported employment	6 (14.6)	1 (1.7)	0 (0.0)
Training	2 (4.9)	3 (5.2)	5 (5.9)
Housewife	1 (2.4)	1 (1.7)	4 (4.7)
Retired	17 (41.5)	23 (39.7)	0 (0.0)
Unemployed	3 (7.3)	6 (10.3)	0 (0.0)

Abbreviations; MWT-B = Mehrfachwahl-Wortschatz–Test-B, PANSS = Positive and Negative Syndrome Scale, MADRS = Montgomery–Åsberg Depression Rating Scale, YMRS = Young Mania Rating Scale, GAF = Global Assessment of Functioning Scale, MS = mood stabilizer, AP = antipsychotic, AD = antidepressant.
* p = 0.058 trend-level significance, Mann–Whitney *U* test.
** p < 0.001 Chi-square test (schizophrenia patients vs. controls, bipolar patients vs. controls).
*** p = 0.026 Chi-square test (schizophrenia patients vs. bipolar patients).

2.3. Psychosocial Functioning

Psychosocial functioning was evaluated through the assessment of the participants' partnership and employment status, and by assessing their living situation. In addition, the Global Assessment of Functioning Scale (GAF; American Psychiatric Association, 1994) was used in patients.

2.4. Statistical analyses

Depending on the variable type (categorical, normally and non-normally distributed metric variables, respectively), the Chi-square

Table 2
CATS subtest 8 (percent correct answers): comparison of schizophrenia patients, bipolar patients and healthy controls.

Emotion	Group						Comparison		
	Schizophrenia (S) N = 41		Bipolar (B) N = 58		Control (C) N = 85		Overall[a]		Individual groups[b]
	Mean	SD	Mean	SD	Mean	SD	χ^2	p-Value	
Total score	58.4	15.9	57.1	16.2	63.0	13.5	5.800	0.055	B < C (p = 0.016)
Happiness	29.3	22.0	29.3	25.2	30.8	21.5	0.499	0.779	–
Sadness	67.1	24.6	65.8	22.8	72.2	23.2	2.908	0.234	–
Anger	79.3	24.4	81.3	23.4	90.4	13.0	6.720	0.036	S < C (p = 0.023) B < C (p = 0.044)
Fright	52.2	27.2	45.5	28.7	51.3	27.2	1.908	0.385	–

Abbrevation: CATS = Comprehensive Affective Testing System.
[a] Kruskal–Wallis test.
[b] Mann–Whitney *U*-test.

test, one-way analysis of variance, and the Kruskal–Wallis test were used for comparison of schizophrenia patients, BD patients, and healthy control subjects with respect to demographic and clinical characteristics. The Kruskal–Wallis test was also employed to compare the three groups with regard to APP (CATS subtest 8, percent correct answers in total and separately for each emotion). Non-parametric statistical tests were used as the dependent variable showed significant departures from a normal distribution for each individual emotion (Shapiro–Wilks test, d.f. = 184, W < 0.98, p < 0.05). Whenever the Kruskal–Wallis test indicated significant group differences, post-hoc pairwise comparisons were performed by means of the Mann–Whitney *U*-test. Misidentifications (percentage of cases where emotion X was mistaken for emotion Y) were analyzed in the same way.

Multiple linear regression analysis with backward variable elimination was used to investigate the joint effect of demographic and clinical variables on APP within individual groups. Demographic variables considered were age, gender, and education; clinical variables comprised the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987) in schizophrenia patients, and MADRS and YMRS in BD patients. Functional variables considered were GAF, employment status, partnership and independent living.

3. Results

3.1. Sample characteristics

41 patients with schizophrenia, 58 BD patients, and 85 healthy control subjects were included into the study. Demographic and clinical characteristics are summarized in Table 1. Patients and control subjects were comparable with respect to age, sex, and education. Mean PANSS, MADRS, and YMRS total scores confirmed symptomatic remission in patients, and there were no significant differences between the two groups with regard to duration of illness and premorbid intelligence. As expected, patients and control subjects differed significantly with respect to partnership, employment status, and living situation.

3.2. Affective prosody perception

An overview of patients' and control subjects' APP abilities, as assessed by the CATS subtest 8, is given in Tables 2 and 3. In comparison to healthy controls, BD patients achieved a significantly lower CATS subtest 8 total score, and both schizophrenia and BD patients were significantly impaired in identifying anger. With respect to misidentifications, both schizophrenia and BD patients misinterpreted anger significantly more often as neutral prosody compared to healthy control subjects. Furthermore, schizophrenia patients misinterpreted sadness significantly more frequently as happiness, anger, or fright. APP abilities of the two patient groups were not significantly different.

3.3. Association of affective prosody perception (CATS subtest 8) with sociodemographics, psychopathology (PANSS, MADRS, YMRS), and psychosocial functioning (GAF, partnership, independent living, employment status)

The results of the multiple linear regression analysis are summarized in Table 4. Increasing age was negatively associated with the CATS subtest 8 total score in schizophrenia patients and healthy controls and with the identification of anger in both patient groups. In addition, it was negatively associated with the identification of happiness and sadness in control subjects. Education was positively associated with the CATS subtest 8 total score and with the identification of sadness and fright among BD patients. Neither gender nor patients' duration of illness showed a significant association with APP abilities.

With one exception, residual symptomatology did not show any significant associations with APP abilities in patients. The exception refers to the degree of positive symptoms in schizophrenia patients, which was negatively associated with the identification of happiness. No significant associations were observed between APP performance and functioning (GAF, partnership, independent living, employment status).

Table 3
Comparison of groups with regard to CATS subtest 8: correct answers and misidentifications (percentage scores).

Group	Presented emotion	Answer given				
		Happiness	Sadness	Anger	Fright	Neutral
Schizophrenia	Happiness	**29.3**	3.9	29.8	23.4	13.7
	Sadness	2.8↑[a]	**67.1**	4.5↑[b]	4.5↑[c]	21.1
	Anger	2.4	.0	**79.3**↓[d]	9.8	8.5↑[e]
	Fright	20.5	1.0	9.3	**52.2**	17.1
Bipolar	Happiness	**29.3**	1.4	29.7	27.6	12.1
	Sadness	1.1	**65.8**	2.3	1.4	29.3
	Anger	2.3	1.1	**81.3**↓[f]	9.2	6.0↑[g]
	Fright	25.5	1.0	9.0	**45.5**	19.0
Control	Happiness	**30.8**	1.6	26.8	29.6	11.1
	Sadness	0.4	**72.2**	1.6	0.6	25.3
	Anger	1.6	0.4	**90.4**	5.3	2.4
	Fright	21.9	0.2	7.8	**51.3**	18.8

Abbrevation: CATS = Comprehensive Affective Testing System.
Table entries: percent correct answers (bold print) and percent misinterpretations (normal print).
↓ Significantly lower than in the control group, p < 0.05 (Mann–Whitney *U*-test).
↑ Significantly higher than in the control group, p < 0.05 (Mann–Whitney *U*-test).
[a] p = 0.003.
[b] p = 0.016.
[c] p = 0.001.
[d] p = 0.023.
[e] p = 0.005.
[f] p = 0.044.
[g] p = 0.045.

Table 4
Effects of socio-demographic and clinical variables on performance in the CATS subtest 8: results of multiple linear regression analysis.

Dependent variable	Diagnostic group		
	Schizophrenia	Bipolar	Control
CATS subtest 8: Emotions			
Happiness	PANSS positive symptoms: $\beta = -0.532$, $p = 0.017$	–	Age: $\beta = -0.933$, $p = 0.006$
Sadness	–	Education: $\beta = 2.62$, $p = 0.012$	Age: $\beta = -1.246$, $p = 0.001$
Anger	Age: $\beta = -1.37$, $p = 0.002$	Age: $\beta = -0.71$, $p = 0.010$	–
Fright	–	Education: $\beta = 3.18$, $p = 0.015$	–
CATS subtest 8: Total score	Age: $\beta = -0.176$, $p = 0.013$	Education: $\beta = 2.37$, $p = 0.001$	Age: $\beta = -0.736$, $p = 0.001$

Abbreviations: CATS = Comprehensive Affective Testing System, PANSS = Positive and Negative Syndrome Scale.
Table entries: statistically significant predictors, unstandardized beta, p-value.

4. Discussion

In the current study, patients with schizophrenia and BD showed comparable auditory emotion identification impairments despite being symptomatically remitted. This is in contrast to previous studies which found both FAR and APP to be more severely impaired in schizophrenia than in BD patients (e.g., Addington and Addington, 1998; Vaskinn et al., 2007; Lee et al., 2013; Rossell et al., 2013; Yalcin-Siedentopf et al., 2014), and accordingly, emotion perception deficits have been suggested to be a core characteristic of schizophrenia rather than a general finding in SMI (Vaskinn et al., 2007). Our findings, however, do not corroborate this suggestion. Compared to healthy control subjects, overall APP deficits were found in BD but not in schizophrenia patients, and both patient groups were particularly impaired in the identification of anger. This is clinically highly significant, since affect recognition deficits have been shown to be responsible for interpersonal difficulties as well as poor social functioning in people with psychosis (Amminger et al., 2012) and were long believed to remit during euthymic states of BD. Our findings, however, support the view that such deficits represent an enduring deficit and a trait marker of SMI in general.

In agreement with our previous work (Hofer et al., 2009; Hoertnagl et al., 2011; Yalcin-Siedentopf et al., 2014), we found anger to be the best recognized negative emotion among all groups. On the other hand, in comparison to controls both patients with schizophrenia and BD were impaired in identifying this emotion and confounded it frequently with neutral prosody. It is conceivable, that difficulties in the identification of anger may cause particular interpersonal problems, and the vis-à-vis may feel provoked if a person does not react suitably to this emotion. This clearly may lead to a reduction in social effectiveness and diminish the social acceptance of individuals suffering from SMI. Similarly, the frequently observed confusion of sadness with happiness, anger, or fright in schizophrenia patients may lead to an assumption of insensibility due to a supposed lack of compassion, which in turn may have a negative impact on interpersonal relationships. However, we did not particularly address this issue and did not find any association of APP abilities with patients' functioning. Accordingly, further studies addressing this issue as a potential target for therapeutic intervention are warranted.

Overall, we found relatively few associations between APP abilities and clinical variables. Among all groups, affect perception was shown to deteriorate with increasing age, which corroborates previous findings (Calder et al., 2003; Hofer et al., 2009). Interestingly and contrary to previous research, we did not find an association between APP abilities and gender. Vaskinn et al. (2007) found APP impairments only in male schizophrenia patients, whereas Bozikas et al. (2007) reported on such deficits only in female patients suffering from BD. However, these studies are not entirely comparable with ours. The patients included in the former survey were not symptomatically remitted, and the impairment reported in Bozikas et al.'s study was specific to a very small patient sample (11 females, 8 males). In addition, other clinical variables, such as the number of previous episodes and symptoms during acute episodes of the illness, or neurocognitive deficits might hypothetically have a negative influence on APP abilities. Such data were not investigated in the available research and therefore this question remains to be elucidated. Similarly, the reasons behind our finding of a positive association between APP abilities and the level of education in BD patients but not in those suffering from schizophrenia and in healthy controls remain unclear.

With regard to residual symptomatology, we found that schizophrenia patients with less positive symptoms did better in correctly recognizing happy prosody. In contrast, a recently published meta-analysis found only negative symptoms to be inversely associated with affect perception abilities (Chan et al., 2010). However, this report considered exclusively *facial* affect recognition, and clearly, patients' ability to use different communication channels (facial, prosodic intonational) may differ. In addition, one has to consider that patients investigated in the current study met strict remission criteria, and therefore, by definition, presented with low PANSS scores within a very limited range, which renders a meaningful interpretation of the influence of symptoms on APP difficult.

The current study also has some limitations. Firstly, the remission criteria were applied cross-sectionally and patients may have experienced different durations of clinical stability, which in turn may have impacted on APP abilities. Secondly, our patient sample was on psychotropic medication, which may potentially influence APP abilities in different ways. Antipsychotic medication, for example, has been associated with small improvements in emotion perception in schizophrenia patients (Penn et al., 2009), and antidepressants have been demonstrated to differentially modulate emotion processing brain regions (e.g., Brühl et al, 2011). In addition, adverse events such as sedation or extrapyramidal motor side effects may have impacted upon the results.

In summary, the findings of this and our previous study (Yalcin-Siedentopf et al., 2014) support the notion that patients suffering from SMI, even when in symptomatic remission, are in need for continuous psychosocial support as well as metacognitive and social cognition training programs, which have been shown to improve affect recognition, social cognition, and psychosocial functioning (Sachs et al., 2012; Bersani et al., 2013; Rocha and Queirós, 2013).

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Contributors
C.M. Hoertnagl, N. Yalcin-Siedentopf, E.A. Deisenhammer, A. Hausmann, M. Muehlbacher, W.W. Fleischhacker, and A. Hofer designed the study and wrote the protocol. S. Baumgartner, F. Biedermann, and A. Kaufmann managed the literature searches and analyses. G. Kemmler, and A. Rauch undertook the statistical analysis, and C.M. Hoertnagl and A. Hofer wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest
No conflicts of interest for any author.

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