Psychiatry Research ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Psychiatry Research

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

Facial, vocal and musical emotion recognition is altered in paranoid schizophrenic patients

Anne Weisgerber [a,b,*], Nicolas Vermeulen [a,c], Isabelle Peretz [d], Séverine Samson [e], Pierre Philippot [a], Pierre Maurage [a,c], Catherine De Graeuwe D'Aoust [a], Aline De Jaegere [f], Benoît Delatte [g], Benoît Gillain [h], Xavier De Longueville [g], Eric Constant [f,**]

[a] Université catholique de Louvain (UCLouvain), Psychological Sciences Research Institute (IPSY), Louvain-la-Neuve, Belgium
[b] National Research Fund (FNR), Luxembourg
[c] Fund for Scientific Research (F.R.S.–FNRS), Belgium
[d] International Laboratory for Brain, Music, and Sound research (BRAMS), Université de Montréal, Canada
[e] Neuropsychology and Auditory Cognition, University Lille-Nord de France, France
[f] Department of Adult Psychiatry, Université catholique de Louvain (UCLouvain), Institute of Neurosciences (IoNS), 1200 Brussels, Belgium
[g] Psychiatric Hospital Beau Vallon, Namur, Belgium
[h] Clinique Saint-Pierre, Ottignies, Belgium

ARTICLE INFO

Article history:
Received 20 September 2014
Received in revised form
16 June 2015
Accepted 12 July 2015

Keywords:
Schizophrenia
Emotion
Music
Face
Voice

ABSTRACT

Disturbed processing of emotional faces and voices is typically observed in schizophrenia. This deficit leads to impaired social cognition and interactions. In this study, we investigated whether impaired processing of emotions also affects musical stimuli, which are widely present in daily life and known for their emotional impact. Thirty schizophrenic patients and 30 matched healthy controls evaluated the emotional content of musical, vocal and facial stimuli. Schizophrenic patients are less accurate than healthy controls in recognizing emotion in music, voices and faces. Our results confirm impaired recognition of emotion in voice and face stimuli in schizophrenic patients and extend this observation to the recognition of emotion in musical stimuli.

1. Introduction

Research and clinical reports have repeatedly shown that schizophrenia is associated with affective deficits (e.g., anhedonia, avolition, alogia, flat affect) and many studies suggest a global emotional deficit in schizophrenic patients (SP) (Putnam and Kring, 2007; Kring and Elis, 2013). These deficits seem to be related to social function vulnerability previously observed in schizophrenia (Hooker and Park, 2002). SP present deficits in social skills and social cognition, which means difficulties in the mental operations related to social interactions (Brüne, 2005). These are perception, understanding, anticipation and reaction to social warnings, which are crucial for adapted social interactions like the generation of responses to the intentions and behaviors of others (Hoekert et al., 2007; Green et al., 2008). Disturbances at the level of social cognition may explain impairments in social functioning (Pinkham et al., 2003). Given that vocal and facial emotional recognition are important basic aspects of social cognition, deficits at this level may lead to a decrease in social capacities, particularly in interpersonal misunderstanding, or inadequate social behavior (Pinkham and Penn, 2006). According to these findings, Couture et al. (2006) report significant associations between emotion perception and social behavior in schizophrenia. Diminished affective expression and recognition have been regularly identified in faces and speech prosody in SP who often show reduced emotional expressivity and a deficit in emotional identification of vocal (Kurcharska-Pietura et al., 2005; Rossell and Boundy, 2005) and facial expressions (Edwards et al., 2001).

One remaining question is whether the deficit in emotion recognition in SP is limited to aspects of social communication (i.e., in faces and voices) or whether it may be more general and would involve other affective stimuli (e.g., music, odors).

To our knowledge no study has examined the ability of SP to recognize emotions in music. This aspect may be particularly

* Corresponding author at: Psychological Sciences Research Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium.
** Correspondence to: Instute of Neurosciences, Cliniques Universitaires Saint-Luc, Avenue Hippocrate, 10, 1200 Bruxelles, Belgium. Fax: +322 764 8921.
E-mail addresses: Anne.Weisgerber@uclouvain.be (A. Weisgerber), Eric.Constant@uclouvain.be (E. Constant).

http://dx.doi.org/10.1016/j.psychres.2015.07.042
0165-1781/© 2015 Published by Elsevier Ireland Ltd.

interesting because music is a constant companion throughout life and previous studies reported differences in emotion recognition in voice and music. Escoffier et al. (2013), for example, found different cerebral activation in emotion and pitch evaluation in voice and music. Furthermore, Weiss et al. (2012) reported that a melody was better recognized when it is sung by a voice (i.e. biological significant timbre) than when it's played by an instrument.

Music is indeed all around us everyday, either voluntarily (e.g. mp3 listening) or not (e.g. restaurant and in-store music, Bruner, 1990). Recent research on music use in everyday life showed that music is present in 37–9% of the reported life situations (North et al., 2004; Juslin et al., 2008). In 64% of the episodes involving music, participants reported that music influenced their emotional state (Juslin et al., 2008). Besides, several studies enlightened the frequent use of music for emotion regulation (Saarikallio, 2010; VanGoethemand Sloboda, 2011; Skanland, 2013).

Furthermore, similar emotion-specific acoustic cues are used to communicate emotion in speech and music (Juslin and Laukka, 2003). The authors cite speech rate/tempo, voice intensity/sound level, voice quality/timbre and F0/pitch as the most powerful and common features for both expressions. Music was considered as a complementary system to language for maintaining social bonds millions of years ago (Thompson, 2009). Although, today music goes beyond its social characteristics and is able to accompany people everywhere they are (e.g., mp3 player, Skanland, 2013).

A growing body of research discuss the fact that music listening through mp3 player may lead to a social isolation of the person (Bull, 2007; Skanland, 2013). Bull (2007) reports that people admit resenting people who interrupt their music listening to talk to them. Likewise, music is described as"armor" against outside stimuli and a possibility for listeners to manage their state of mind by isolating themselves from their surroundings (Skanland, 2013). We argue that the music used in today's context presents an additional mean for social interaction regulation.

Moreover, some authors suggest that SP use music as an active coping strategy for hallucinations and emotion regulation (Farhall et al., 2007). Minato and Zemke (2004) indeed observed that SP without work-related routines tend more to listen to music, watching television and reading magazines.

Considering the parallels between vocal and musical emotion processing, the objective of the present study was to investigate whether SP show a deficit in emotion recognition in music as well. Analysis of emotion perception from musical cues could provide further insight into emotion perception in SP and, if present, may lead to further questions for the research and clinical implications of music for SP.

2. Method

2.1. Participants

Thirty paranoid schizophrenic individuals (19 women, 11 men) were recruited through the Department of Psychiatry of the *Cliniques Universitaires Saint-Luc* (Brussels, Belgium), the *Hôpital Psychiatrique du Beau Vallon* (Namur, Belgium) and Saint-Pierre Clinic Psychiatric Department (Ottignies, Belgium). The subgroup of paranoid schizophrenic patients was chosen in order to obtain a standardized sample. Exclusion criteria were current or past neurological disease (e.g., epilepsy, dementia, vascular cerebral accident), auditory deficits and substance dependency comorbidity. All participants were in a stable phase for at least 6 months under atypical and mixed (typical and atypical) antipsychotics. Psychopathology was assessed with PANSS (Kay et al., 1987) and SANS (Andreasen, 1984).

Thirty healthy participants were recruited, by matching each individual patient to a specific control for gender, age and education. Exclusion criteria were current or past neurological disease, personal or siblings' psychiatric disease. Given the one-to-one individual matching, samples did not differ in sex (19 women, 11 men), age ($t(58)=0.19$, ns), or education ($t(58)=-0.72$, ns). Clinical and demographic characteristics of the groups are shown in Table 1.

Table 1
Clinical and demographic characteristics of schizophrenia patients and healthy controls.

	Schizophrenic patients *N*=30 Means (S.D.)	**Healthy controls *N*=30 Means (S.D.)**
Male/female	11/19	11/19
Age, years	35.5 (12.7)	34.9 (14.3)
Years of education	12 (2.19)	12.5 (1.71)
Number of years of illness	10.9 (9.4)	NA[a]
Age of onset of disease	24.6 (9.9)	NA[a]
Medication: Atypical Aps/ Typical and Atypical Aps	22/8	NA[a]
BDI-II	14.76 (10,6)	3.44 (3.44)
STAI-Y A	49.7 (12,1)	42.1 (7.56)
STAI-Y B	52 (11.1)	40.0 (5.3)
D2	18.9 (24.1)	41.7 (28.1)
PANSS positive	17.9 (6.1)	NA[a]
Negative	21.1 (7.2)	NA[a]
General	38.5 (10.0)	NA[a]
Total	72.2 (27.0)	NA[a]
SANS	41.4 (18.5)	NA[a]

[a] Not Applicable.

2.2. Procedure

The Ethical Committee of the Medical Faculty of the Université Catholique de Louvain approved the design. After a thorough description of the study, informed consent was obtained from the participants. The experiment was divided into two sessions to prevent overloading and to maintain participant's concentration. Firstly, the participants completed the questionnaires and the music task; secondly, they evaluated the vocal and facial stimuli.

2.2.1. Clinical assessment and control measures

Depression was measured by the Beck's Depression Inventory (BDI, French version in 21 items (Beck et al., 1961) and state/trait anxiety by the State Trait Anxiety Inventory (Spielberger, 1983). Attention ability, evaluated using the D2 attention test (Brickenkamp, 1969), was used as a cognitive control measure.

2.2.2. Experimental tasks

The musical material consisted of 56 validated excerpts selected from Vieillard et al. (2008), 14 in each of four emotion categories (happiness, sadness, threat, peacefulness). The excerpts were computer-generated and recorded in a piano timbre in Western tonal system. Participants were instructed to rate the intensity of the four emotions using a 10-point scale (from 0 for absent to 9 for highly present).

A validated set of non-verbal vocal affect bursts (Belin et al., 2008) was computer-recorded from five male and five female actors. The bursts expressed seven different emotions: anger, disgust, fear, sadness, surprise, joy and neutrality. Thirty-five excerpts were used in order to have 5 for each of the six emotions. Participants were instructed to rate the intensity of the six emotional and neutral voices using a 10-point scale (from 0 for absent to 9 for highly present).

A series of 25 validated facial stimuli were computer-generated from three male and two female faces (Maurage et al., 2007). The facial stimuli expressed five different emotions (joy, sadness, fear, anger and neutrality). Participants were instructed to rate the intensity of the four emotional and neutral faces using a 10-point scale (from 0 for absent to 9 for highly present).

For all stimuli, they had to judge whether the excerpt explicitly expressed the chosen emotion on the scale. Participants had been previously informed that they had to provide a rating for all emotion labels. As participants were asked to rate the stimuli on a 10-point scale, intensity ratings have been calculated from the mean ratings of all emotion labels for all stimuli from the same emotion (e.g. FHH is the mean rating of a happy face on the happy emotion scale, FHS is the mean rating of a happy face on the sad emotion scale). All these ratings (hits and misses) have been integrated in the intensity rating analysis.

Accuracy scores (1 point) were given when participants gave the maximal rating for the intended emotion. When they did not rate the target emotion as the highest or when two emotions received the same highest rating, no point was given. For the neutral stimuli, participants received one point if they rated all the emotional labels as 0 (absence of the emotion). This method, used by Vieillard et al. (2008) for the validation of musical excerpts, was entirely transferred to the present study. This method allows us to get out of a binary rating to a continuous variable and requires more discriminant evaluation capacities leading to more hidden group or emotion error types (over/underestimation). The same method has already been used by Naranjo et al. (2011) and Kornreich et al. (2012) to compare emotion recognition capacities in major depression and alcoholism.

3. Results

All the statistical analyses were conducted using SPSS. For each emotional task, decoding accuracy scores and intensity ratings were examined using Multivariate analysis of variance (MANOVA) with Stimulus (music, face and voice) and Intensity rating as within-subject factors and Group as a between-subjects factor. All analyses were conducted using two-tailed significance tests at the 0.05 level. Post-hoc analyses were run when needed.

Preliminary correlations between recognition accuracy and independent measures (STAI, BDI, D2) were realized using two-way Spearman coefficients. No significant correlations were observed between BDI, STAI-B and d2 and accuracy. Therefore all following analyses were collapsed across these factors.

Participants were matched for gender between groups, but in-group gender distributions were not equal (19 women and 11 men). Therefore we controlled for in-group gender differences, which were not significant for music $F_{(1,28)}=0.847$, $p>0.05$, $\eta^2=0.02$ (SP); $F_{(1,28)}=0.018$, $p>0.05$, $\eta^2=0.00$ (NC), face $F_{(1,28)}=2.286$, $p>0.05$, $\eta^2=0.07$ (SP); $F_{(1,28)}=0.157$, $p>0.05$, $\eta^2=0.00$ (NC) and voice $F_{(1,28)}=0.073$, $p>0.05$, $\eta^2=0.00$ (SP); $F_{(1,28)}=0.743$, $p>0.05$, $\eta^2=0.02$ (NC). General results are shown in Table 2.

3.1. Emotion recognition accuracy

3.1.1. Music

SP were significantly less accurate (mean=0.49; SD=0.03) in the identification of emotions than controls (mean=0.65; SD=0.03), $F_{(1,58)}=8.169$, $p<0.006$, $\eta^2=0.12$ (Table 3). We also found a main effect of emotion, $F_{(3,56)}=15.987$, $p<0.0001$, $\eta^2=0.46$, demonstrating that happiness (mean=0.73, SD=0.03) was most accurately recognized, followed by threat (mean=0.60, SD=0.03), peacefulness (mean=0.46, SD=0.04), and sadness (mean=0.47, SD=0.03). The means were significantly different, except between peacefulness and sadness. No Group × Stimulus interaction was found.

Table 2
F-values for MANOVA.

	Sources	*F*	df	sig	η^2
Accuracy scores					
Music accuracy scores	Group	8.169	1,58	0.006	0.12
	Stimulus	15.987	3,56	< 0.0001	0.46
	Group × Stimulus	1.014	3,56	ns	0.05
Voice accuracy scores	Group	9.630	1,58	0.003	0.14
	Stimulus	48.252	6,53	< 0.0001	0.84
	Group × Stimulus	1.280	6,53	ns	0.13
Face accuracy scores	Group	9.616	1,58	0.003	0.14
	Stimulus	38.201	4,55	< 0.0001	0.73
	Group × Stimulus	3.198	4,55	0.020	0.018
Intensity scores					
Music intensity scores	Group	3.587	1,58	0.063	0.06
	Stimulus	6.184	3,56	0.001	0.25
	Intensity	5.401	3,56	0.002	0.22
	Group × Intensity	1.198	3,56	ns	0.06
	Group × Stimulus	0.672	3,56	ns	0.03
	Stimulus × Intensity	45.578	9,50	< .0001	0.89
	Group × Stimulus × Intensity	1.444	9,50	ns	0.20
Voice intensity scores	Group	1.072	1,58	ns	0.02
	Stimulus	16.801	6,53	< 0.0001	0.65
	Intensity	22.834	5,54	< 0.0001	0.68
	Group × Intensity	0.938	5,54	ns	0.08
	Group × Stimulus	0.921	6,53	ns	0.09
	Stimulus × Intensity	14.030	30,29	< 0.0001	0.93
	Group × Stimulus × Intensity	1.609	30,29	ns	0.63
Face intensity scores	Group	2.648	1,58	ns	0.04
	Stimulus	22.348	4,55	< 0.0001	0.62
	Intensity	13.339	3,56	< 0.0001	0.42
	Group × Intensity	0.827	3,56	ns	0.04
	Group × Stimulus	1.458	4,55	ns	0.09
	Stimulus × Intensity	63.867	12,47	< 0.0001	0.94
	Group × Stimulus × Intensity	2.399	12,47	0.016	0.38

Note: ns > .05

Table 3
Mean (SD) emotion accuracy scores for music, voice and face in schizophrenic patients (SP) and normal controls (NC).

	SCH	NC
Music	0.47^{a} (.25)	0.64^{b} (.15)
Voice	0.47^{a} (0.16)	0.58^{b} (0.15)
Face	0.59^{a} (0.22)	0.76^{b} (0.19)

Note: Between columns (SP, NC) different exponents mean that the results are significantly different $p<.05$.

3.1.2. Voice

SP were significantly less accurate than controls in the identification of emotions, $F_{(1,58)}=9.630$, $p<0.003$, $\eta^2=0.14$ (Table 3). Both groups also showed an emotion effect but no Group × Stimulus interaction. In general, participants identified happiness (mean=0.78, SD=0.36^{a}), sadness (mean= 0.74, SD=0.35^{a}) and disgust (mean=0.74, SD=0.35^{a}) more accurately than surprise (mean=0.53, SD=0.38^{d}), fear (mean=0.41, SD=0.37^{b}) and neutrality (mean=0.34, SD=0.50^{b}). Finally, anger (mean=0.18, SD=0.25^{c}) was identified the less accurate than from all emotional vocalizations. Different exponents mean that the results are significantly different at $p<0.05$.

3.1.3. Face

SP were significantly less accurate in the identification of facial emotions than the controls ($F_{(1,58)}$ =9.616, $p<0.003$, $\eta^2=0.14$) (Table 3). Post-hoc analyses using one-way ANOVA were

Table 4
Mean (SD) emotion accuracy scores for different emotional faces in schizophrenic patients (SP) and normal controls (NC).

	Angry	Fearful	Happy	Neutral	Sad
SP	$0.77^{a,1}$ (0.06)	$0.50^{a,2}$ (0.07)	$0.89^{a,3}$ (0.04)	$0.25^{a,4}$ (0.06)	$0.54^{a,2}$ (0.07)
NC	$0.82^{a,1}$ (0.05)	$0.81^{b,1}$ (0.04)	$0.96^{a,2}$ (0.03)	$0.44^{b,3}$ (0.08)	$0.75^{b,1}$ (0.06)

Note: Between rows (a,b,c) and columns (1,2,3), different exponents mean that the results are significantly different $p<0.05$.

conducted to investigate the Group × Stimulus interaction ($F_{(4,55)}=3.198$, $p<0.02$, $\eta^2=0.18$). The schizophrenic group was significantly less accurate than the controls in identifying sadness ($p<0.001$), fear ($p<0.0001$) and neutral faces ($p<0.004$) but not joy ($p=0.27$) or anger ($p=0.422$). SP recognized joy and anger with the greatest accuracy, followed by sadness and fear. Participants in the control group rated joy and anger most accurately, followed by fear and sadness. Results of the interaction effect are shown in Table 4.

3.2. Emotion intensity rating

3.2.1. Music

There was a trend towards a difference between the groups in overall intensity ratings for musical stimuli, ($F_{(1,58)}=3.587$, $p=0.06$, $\eta^2=0.06$), with a tendency for SP (mean=3.47, SD=0.18) to rate music as more emotionally intense than controls did (mean=2.97, SD=0.18). Post-hoc analyses using one-way Anovas were conducted to investigate the Stimulus × Intensity interaction ($F_{(9,50)}=45.57$, $p<0.001$, $\eta^2=0.89$). The rating results for the different music excerpts are illustrated in Table 5.

3.2.2. Voice

Overall, we found a general stimulus ($F_{(6,53)}=16.8$, $p<0.001$, $\eta^2=0.65$) as well as a general intensity effect ($F_{(5,54)}=22.83$, $p<0.001$, $\eta^2=0.68$). Participants rated surprise (mean=3.12, SD=0.22) as having the greatest intensity, followed by disgust (mean=2.42, SD=0.19) and fear (mean=2.38, SD=0.17). Post-hoc analyses using one-way Anovas were conducted to investigate the Stimulus × Intensity interaction, ($F_{(30,29)}=14.03$, $p<0.001$, $\eta^2=0.93$). For all emotional voices, the correct emotion was rated with the highest intensity, except for the anger stimulus, which was misinterpreted as surprise.

3.2.3. Face

We didn't find a general group effect, but either a stimulus, ($F_{(4,55)}=22.35$, $p<0.001$, $\eta^2=0.62$) and intensity effect, ($F_{(3,56)}=13.33$, $p<0.001$, $\eta^2=0.42$). Further, we found a two-way Stimulus × Intensity interaction and Post-hoc analyses using one-way Anovas were conducted to investigate the Group × Intensity × Stimulus interaction, ($F_{(12,47)}=2.39$, $p<0.05$, $\eta^2=0.38$). We found a significant group × emotion effect for anger, $F_{(3,56)}=2.861$, $p<0.045$, and fear, $F_{(3,56)}=3.179$, $p<0.031$. A more detailed analysis showed that SP (mean=3.92, SD=2.7) rated the fearful faces significantly higher on the sadness scale than did normal controls (mean=2.28, SD=1.63). Results are shown in Table 5.

3.3. Correlational analyses (PANSS, SANS)

In the emotion recognition accuracy for all music stimuli, recognition scores negatively correlated with PANSS positive scores ($r=-0.380$ to -0.540; $p<0.05$) for SP. The more positive symptoms were present, the less able were SP to correctly identify the different emotional musical stimuli. These coefficients became non-significant after applying Bonferroni correction for multiple correlations ($p<0.05/20=p<0.002$). In emotion recognition accuracy for facial stimuli, there were two negative correlations between recognition scores and PANSS positive scores for sad faces ($r=-0.364$; $p=0.05$) and joyful faces ($r=-0.397$; $p=0.05$). These coefficients became non-significant after applying Bonferroni correction for multiple correlations ($p<0.05/25=p<0.002$). No other correlations, with SANS or PANSS negative scores have been found.

4. Discussion

The present study investigated the processing of emotional information in schizophrenic individuals. Our results show that SP have impaired ability to accurately identify emotional content from faces, voices and music. A deficit in emotion identification of social stimuli (face and voice) has already been well documented for SP (Kurcharska-Pietura et al., 2005; Constant et al., 2011; Comparelli et al., 2013).

In line with these findings, we found a group with emotion interaction for face identification. As in previous studies, we observed that impairments for SP were strongest in detecting fearful

Table 5
Mean (SD) intensity ratings for music and face stimuli in schizophrenic patients (SP) and normal controls (NC).

		Rating	Fearful	Happy	Sad	Angry	Peaceful
Music	Fearful	SP	5.96^{a} (0.38)	1.87^{b}(0.29)	3.37^{c} (0.45)	/	1.67^{b}(0.32)
		NC	5.80^{a} (0.33)	1.34^{b}(0.21)	2.89^{c} (0.35)	/	1.13^{b} (0.23)
	Happy	SP	1.63^{a} (0.38)	7.06^{b}(0.32)	1.09^{c}(0.27)	/	4.10^{d}(0.46)
		NC	0.60^{a}(0.17)	7.12^{b}(0.21)	0.55^{a} (0.13)	/	2.99^{d}(0.33)
	Sad	SP	3.51^{a} (0.40)	1.75^{b}(0.33)	5.52^{c}(0.35)	/	3.36^{a} (0.40)
		NC	2.49^{a} (0.31)	1.02^{b} (0.22)	5.61^{c} (0.34)	/	3.33^{a}(0.34)
	Peaceful	SP	$1.70^{a,b}$ (0.28)	3.79^{b}(0.45)	3.33^{a}(0.38)	/	$5.87^{a,b}$(0.32)
		NC	$1.29^{a,b}$ (0.23)	2.81^{b} (0.27)	3.26^{b}(0.33)	/	$5.32^{a,b}$ (0.29)
Face	Fearful	SP	5.76^{a} (0.40)	0.43^{b} (0.15)	3.92^{c} (0.49)	1.49^{d} (0.43)	/
		NC	5.97^{a} (0.39)	0.50^{b} (0.16)	2.29^{c} (0.30)	1.13^{d} (0.27)	/
	Happy	SP	1.12^{a} (0.33)	7.28^{b} (0.35)	0.54^{c} (0.21)	0.52^{c} (0.17)	/
		NC	0.67^{a} (0.21)	7.05^{b} (0.31)	0.41^{c} (0.14)	0.40^{c} (0.15)	/
	Sad	SP	3.61^{a} (0.49)	0.39^{b} (0.14)	6.03^{c} (0.40)	1.72^{d} (0.43)	/
		NC	2.17^{a} (0.43)	0.41^{b} (0.13)	6.41^{c} (0.35)	1.37^{d} (0.29)	/
	Angry	SP	3.17^{a} (0.57)	0.40^{b} (0.17)	0.58^{b} (0.17)	7.60^{c} (0.23)	/
		NC	2.16^{a} (0.47)	0.42^{b} (0.16)	0.99^{c} (0.26)	7.23^{d} (0.34)	/
	Neutral	SP	3.09^{a} (0.43)	1.83^{b} (0.4)	2.18^{c} (0.40)	1.56^{b} (0.31)	/
		NC	1.96^{a} (0.30)	0.82^{b} (0.26)	1.50^{a} (0.26)	1.07^{b} (0.22)	/

Note: Between columns, different exponents mean that the results are significantly different $p<0.05$.

Please cite this article as: Weisgerber, A., et al., Facial, vocal and musical emotion recognition is altered in paranoid schizophrenic patients. Psychiatry Research (2015), http://dx.doi.org/10.1016/j.psychres.2015.07.042

faces (Leitman et al., 2007; Comparelli et al., 2013). A possible explanation is that SP avoid looking at important facial regions to detect emotion (especially in people's eyes). Indeed, healthy individuals process the eye region of fearful faces faster and more easily than other regions (Morris et al., 2009). In our study, SP misinterpreted fearful faces as sad faces, confirming the above-mentioned deficit. However, SP also misinterpreted neutral faces as fearful. Mier et al. (2014) found that SP show greater tendency to attribute negative emotions to neutral stimuli. These results may be linked to greater amygdala activation in patients when evaluating neutral stimuli.

Furthermore, we found general emotion effects for all participants and every modality (music, face, voice). Overall, participants recognized more accurately happy stimuli than other stimuli. Kurcharska-Pietura et al. (2005) also mentioned a main effect of emotion with facilitation for happy stimuli. An explanation for this finding is that, especially in the vocal and facial category, participants were asked to rate more negative than positive emotions. It would thus be easier to distinguish positive from negative stimuli than to distinguish between different negative stimuli, which need more cues to be discriminated. This explanation is in line with the distinctiveness effect found in emotion recognition (Dewhurst and Parry, 2000). Furthermore, a happy face is easier to identify than an angry face and this could be related to the simple perceptual properties of the stimuli (Mermillod et al., 2009). More recent studies confirm and extend the effect to all negative emotions, because of the u-shaped mouth form of happy face (Kirita and Endo, 1995).

Therefore we emphasize the music rating part of our study. Indeed, in this modality two positive (happy, peaceful) and two negative (threat, sad) emotions as well as two highly arousing (happy, threat) and two less arousing (sad, peaceful) characteristics are used. In this case, the arousal level of the stimuli may affect the emotion identification distribution we observed, because participants rated the highly arousing stimuli more accurately than the less arousing stimuli. Leitman et al. (2010) found that SP show reduced sensitivity and use more intensity cues to identify auditory emotions to balance out their deficit in pitch-based cues. In line with their observations, we found a tendency suggesting that SP perceived the musical stimuli as more intense than the control subjects.

In addition to previous findings reporting a deficit of emotion identification of social stimuli, we found that SP also show deficits in identifying the emotion of musical stimuli. As presented earlier, these impairments suggest that music and voice share several features of sound production. Indeed, speech prosody and music include rhythm, pitch, melody, tempo and volume as part of emotional non-verbal information (Leitman et al., 2010; Weisgerber et al., 2013). Some studies already observed auditory deficits in SP for nonverbal vocal cues (Leitman et al., 2010) and more recent studies raise the argument that these deficits may be linked to an identification deficit of more general music features (i.e. amusia, Hatada et al., 2014; Kantrowitz et al., 2014; Wen et al., 2014). Moreover, several authors (Leitman et al., 2005; Kring and Elis, 2013) propose that visual and auditory channels show different sensory-driven deficits in emotion identification and that emotion perception deficits are linked to general perception deficits (e.g. face processing and pitch processing).

As mentioned earlier, music is nowadays a current company in people's life. Moreover, music is one of the preferred coping strategies of SP (Hayashi et al., 2002). Farhall et al. (2007) suggested that schizophrenic patients either use music to regulate their emotions or because of its competitive character to confront auditory hallucinations. In that matter, we would like to draw attention to possible maladaptive use of music for everyday emotion regulation (Miranda et al., 2013). The authors cite different studies, which emphasize the possible influence of maladaptive self-regulation through music. Miranda and Claes (2007) for example, found that even after controlling for confounders (drug use, anxiety, school problems), metal music was linked to more depression in adolescent girls. Furthermore, North and Hargreaves (2006) showed that hard rock, hip-hop and punk predicts suicide ideation in university students. SP may use music listening in a maladaptive way when they try to resist the voices by drowning them out with loud music. In their meta-analysis, Farhall et al. (2007) pointed out that resistance to voices may have emotional costs for the person and that the effectiveness of the strategy may depends on the situation (e.g. music listening for mild hallucinations vs ineffective for more intrusive ones).

Despite all these findings, some limitations have to be noted. Firstly, it was not possible to compare the different tasks of emotion recognition because we used different categorization in emotional stimuli (from the original validation) for the musical, vocal and facial stimuli. Furthermore, neutral items were evaluated only through emotion rating scales; this may induce a risk of rating anyway on the emotional scales because of the lack of a neutral option.

Furthermore, recent research observed that SP might present a more basic perception deficit in the visual and auditory domain (e.g. amusia), which may explain a part of the deficits observed in this study.

Nevertheless, our results confirm deficits in emotion identification of faces and voices in SP, functions that are essential for adequate social functioning. We also found a deficit in emotion detection of music, with higher intensity ratings in SP than in controls.

To sum up, SP show difficulties to recognize emotions from faces, voices and music, which is consistent with a generalized emotion decoding impairment. Schizophrenia has also been associated with impairments of emotion identification in self and others and is still strongly linked to social cognition deficits as well. Clinical consequences include potential misattributions of emotions to others, with possible interpersonal relationships difficulties and higher risk of relapse. Moreover, SP show emotion identification impairments for musical stimuli. However, previous research observed that these impairments might be linked to a more basic perception deficit (Leitman et al., 2005; Kring and Elis, 2013).

After all, Farhall et al. (2007) reported that SP often use music as coping strategy for hallucinations and emotion regulation and sometimes maybe in a maladaptive way.

Nevertheless, in a meta-analysis, Gold et al. (2005) described that music therapy has a positive effect on general symptoms and negative symptoms of schizophrenia. Moreover, Skanland (2013) reported that participants (non clinical population) sometimes use music to investigate their mood and that it can help to find out in what mood the person is, to feel it, to understand it and then to react. These results should encourage further investigations into music and emotion research within clinical populations to understand the modes of music listening and how to promote healthy listening habits.

Contributors

Eric Constant designed the study and managed the project in general.

Anne Weisgerber revised the statistical analysis and the draft of the manuscript.

Catherine de Graeuwe d'Aoust and Aline De Jaegere undertook the data collection and statistical analysis.

Benoît Delatte, Benoît Gillain and Xavier De Longueville managed the data collection.

Isabelle Peretz and Séverine Samson designed the study and provided the musical stimuli.

Pierre Maurage provided the facial stimuli, revised the statistical analysis and the manuscript.

Pierre Philippot, and Nicolas Vermeulen approved the final manuscript.

Conflict of interest

None.

Acknowledgment

This work was supported by grants from the Special Research Fund of the Catholic University of Louvain (FSR 1058.2011) to Nicolas Vermeulen and the Luxembourg National Research Fund (FNRL 5761586) to Anne Weisgerber.

References

Andreasen, N.C., 1984. The Scale for the Assessment of Negative Symptoms (SANS). University of Iowa, Iowa City.
Beck, A.T., Ward, C.H., Mendelsohn, M., Mock, J., Erbaugh, J., 1961. An inventory for measuring depression. Arch. Gen. Psychiatry 4, 561–571.
Belin, P., Fillion-Bilodeau, S., Gosselin, F., 2008. The Montreal Affective Voices: a validated set of nonverbal affect bursts for research on auditory affective processing. Behav. Res. Methods 40, 531–539.
Brickenkamp, R., 1969. Manuel du test d2 Editest, Bruxelles.
Brüne, M., 2005. Emotion recognition, "theory of mind", and social behaviour in schizophrenia. Psychiatry Res. 133, 135–147.
Bruner, G.C., 1990. Music, Mood and Marketing. J. Mark. 54 (4), 94–104.
Bull, M., 2007. Sound Moves: iPod Culture and Urban Experience (The International Library of Sociology). Routledge, London.
Comparelli, A., Corigliano, V., De Carolis, A., Mancinelli, I., Trovni, G., Ottavi, G., Dehning, J., Tatarelli, R., Brugnoli, R., Girardi, P., 2013. Emotion recognition impairment is present early and is stable throughout the course of schizophrenia. Schizophr. Res. 143, 65–69.
Constant, E., Lancereau, J., Gillain, B., Delatte, B., Ferauge, M., Bruyer, R., 2011. Deficit in negative emotional information processing in schizophrenia: does it occur in all patients? Psychiatry Res. 185, 315–320.
Couture, S.M., Penn, D.L., Roberts, D.L., 2006. The functional significance of social cognition in Schizophrenia: a review. Schizophr. Bull. 32 (S1), S44–S63.
Dewhurst, S.A., Parry, L.A., 2000. Emotionality, distinctiveness, and recollective experience. Eur. J. Cogn. Psychol. 12 (4), 541–555.
Edwards, J., Pattison, P.E., Jackson, H.J., Wales, R.J., 2001. Facial affect and affective prosody recognition in first-episode schizophrenia. Schizophr. Res. 48, 235–253.
Escoffier, N., Zhong, J., Schirmer, A., Qiu, A., 2013. Emotional Expressions in Voice and Music: Same Code, Same Effect? Hum. Brain Mapp. 34, 1796–1810.
Farhall, J., Greenwood, K.M., Jackson, H.J., 2007. Coping with hallucinated voices in schizophrenia: A review of self-initiated strategies and therapeutic interventions. Clin. Psychol. Rev. 27, 476–493.
Gold, C., Heldal, T.O., Dahle, T., Wigram, T., 2005. Music therapy for schizophrenia or schizophrenia-like illnesses. Cochrane Database Syst. Rev. 2, 1–20. http://dx.doi.org/10.1002/14651858.CD004025.pub2 (Art. no. CD004025).
Green, M.F., Penn, D.L., Bentall, R., Carpenter, W.T., Gaebel, W., Gur, R.C., Kring, A.M., Park, S., Silverstein, S.M., Heinssen, R., 2008. Social cognition in schizophrenia: An NIMH Workshop on definitions, assessment, and research opportunities. Schizophr. Bull. 34 (6), 1211–1220. http://dx.doi.org/10.1093/schbul/sbm145.
Hatada, S., Sawada, K., Akamatsu, M., Doi, E., Minese, M., Yamashita, M., Thornton, A., Honer, W., Inoue, S., 2014. Impaired musical ability in people with schizophrenia. J. Psychiatry Neurosci. 39 (2), 118–126.
Hayashi, N., Tanabe, Y., Nakagawa, S., Noguchi, M., Iwata, C., Koubuchi, Y., Watanabe, M., Okui, M., Takagi, K., Sugita, K., Horiuchi, K., Sasaki, A., Koike, I., 2002. Effects of group musical therapy on inpatients with chronic psychoses: a controlled study. Psychiatry Clin. Neurosci. 56, 187–193.
Hoekert, M., Kahn, R.S., Pijnenborg, M., Aleman, A., 2007. Impaired recognition and expression of emotional prosody in schizophrenia: Review and meta-analysis. Schizophr. Res. 96, 135–145.
Hooker, C., Park, S., 2002. Emotion processing and its relationship to social functioning in schizophrenia patients. Psychiatry Res. 112 (1), 41–50.
Juslin, P.N., Laukka, P., 2003. Communication of emotions in vocal expression and music performance: different channels, same code? Psychol. Bull. 129 (5), 770–814.
Juslin, P.N., Liljeström, S., Västfjäll, D., Barradas, G., Silva, A., 2008. An experience sampling study of emotional reactions to music: listener, music and situation. Emotion 8 (5), 668–683.
Kantrowitz, J.T., Scaramello, N., Jakubovitz, A., Lehrfeld, J.M., Laukka, P., Elfenbein, H. A., Silipo, G., Javitt, D.C., 2014. Amusia and protolanguage impairments in schizophrenia. Psychol. Med. 44 (13), 2739–2748.
Kay, S.R., Opler, L.A., Fiszbein, A., 1987. Positive and Negative Syndrome Scale (PANSS): Rating Manual. Karger, San Rafael, CA.
Kirita, T., Endo, M., 1995. Happy face advantage in recognizing facial expressions. Acta Psychol. 89, 149–163.
Kornreich, C., Brevers, D., Canivet, D., Ermer, E., Naranjo, C., Constant, E., Verbanck, P., Campanella, S., Noël, X., 2012. Impaired processing of emotion in music, faces and voices supports a generalized emotional decoding deficit in alcoholism. Addiction 108 (1), 80–88.
Kring, A.M., Elis, O., 2013. Emotion deficits in people with schizophrenia. Annu. Rev. Clin. Psychol. 9, 409–433.
Kurcharska-Pietura, K., David, A.S., Masiak, M., Phillips, M.L., 2005. Perception of facial and vocal affect by people with schizophrenia in early and late stages of illness. Br. J. Psychiatry 187, 523–528.
Leitman, D.I., Foxe, J.J., Butler, P.D., Saperstein, A., Revheim, N., Javitt, D.C., 2005. Sensory contributions to impaired prosodic processing in schizophrenia. Biol. Psychiatry 58, 56–61.
Leitman, D.I., Hoptman, M.J., Foxe, J.J., Saccente, E., Wylie, G.R., Jalbrzikowski, M., Lim, K.O., 2007. The Neural substrates of impaired prosodic detection in schizophrenia and its sensorial antecedents. Am. J. Psychiatry 164, 474–482.
Leitman, D.I., Laukka, P., Juslin, P.N., Saccente, E., Butler, P., Javitt, D.C., 2010. Getting the cue: sensory contributions to auditory emotion recognition impairments in schizophrenia. Schizophr. Bull. 36 (3), 545–556.
Maurage, P., Philippot, P., Verbanck, P., Noel, X., Kornreich, C., Hanak, C., et al., 2007. Is the P300 deficit in alcoholism associated with early visual impairments (P100, N170)? An oddball paradigm. Clin. Neurophysiol. 118, 633–644.
Mermillod, M., Vermeulen, N., Lundqvist, D., Niedenthal, P., 2009. Neural computation as a tool to differentiate perceptual from emotional processes: The case of anger superiority effect. Cognition 110, 246–357.
Mier, D., Lis, S., Zygrodnik, K., et al., 2014. Evidence for altered amygdala activation in schizophrenia in an adaptive emotion recognition task. Psychiatry Res.: Neuroimaging 221, 195–203.
Minato, M., Zemke, R., 2004. Time use of people with schizophrenia living in the community. Occup. Ther. Int. 11 (3), 177–191.
Miranda, D., Claes, M., 2007. Musical preferences and depression in adolescence. Int. J. Adolesc. Youth 13, 285–309.
Miranda, D., Gaudreau, P., Debrosse, R., Morizot, J., Kirmayer, L.J., 2013. Music listening and mental health: variations on internalizing psychopathology. In: MacDonald, R.A.R., Kreutz, G., Mitchell, L. (Eds.), Music, Health and Wellbeing. Oxford University Press, Oxford, pp. 513–529.
Morris, R.W., Weickert, C.S., Loughland, C.M., 2009. Emotional face processing in schizophrenia. Curr. Opin. Psychiatry 22 (2), 140–146.
Naranjo, C., Kornreich, C., Campanella, S., Noël, X., Vandriette, Y., Gillain, B., de Longueville, X., Delatte, B., Verbanck, P., Constant, E., 2011. Major Depression is associated with impaired processing of emotion in music as well as in facial and vocal stimuli. J. Affect. Disord. 128, 243–251.
North, A.C., Hargreaves, D.J., 2006. Problem music and self-harming. Suicide Life-Threat. Behav. 36, 582–590.
North, A.C., Hargreaves, D.J., Hargreaves, J.J., 2004. Uses of music in everyday life. Music Percept. 22 (1), 41–77.
Pinkham, A.E., Penn, D.L., 2006. Neurocognitive and social cognitive predictors of interpersonal skill in schizophrenia. Psychiatry Res. 143, 167–178.
Pinkham, A.E., Penn, D.L., Perkins, D.O., Lieberman, J., 2003. Implications for the neural basis of social cognition for the study of schizophrenia. Am. J. Psychiatry 160, 815–824.
Putnam, K.M., Kring, A.M., 2007. Accuracy and intensity of posed emotional expressions in unmedicated schizophrenia patients: vocal and facial channels. Psychiatry Res. 151, 67–76.
Rossell, S.L., Boundy, C.L., 2005. Are auditory-verbal hallucinations associated with auditory affective processing deficits? Schizophr. Res. 78, 95–106.
Saarikallio, S., 2010. Music as emotional self-regulation throughout adulthood. Psychology of music 39 (39), 307–327.
Skanland, M.S., 2013. Everyday music listening and affect regulation: the role of MP3 players. Int. J. Qual. Stud. Health Well-being 8, 20595.
Spielberger, C.D., 1983. Manual fir the State Trait Anxiety Inventory (form Y), Ca. Consulting Psychologists Press, Palo Alto.
Thompson, W.F., 2009. Music, thought and feeling, Understanding the Psychology of Music. Oxford University Press, New York.
VanGoethem, A., Sloboda, J., 2011. The functions of music for affect regulation. Musicae Sci. 15 (2), 208–228.
Vieillard, S., Peretz, I., Gosselin, N., Khalfa, S., Gagnon, L., Bouchard, B., 2008. Happy, sad, scary and peaceful musical excerpts for research on emotions. Cogn. Emot. 22, 720–752.
Weisgerber, A., Bayot, M., Constant, E., Vermeulen, N., 2013. Music and Cognitive Processing of Emotions: individual differences and psychopathology. In: Simon, P., Szabo, T. (Eds.), Music: Social Impacts, Health Benefits and Perspectives. Nova Science Publishers, New York, pp. 131–148.
Weiss, M.W., Trehub, S.E., Schellenberg, E.G., 2012. Something in the way she sings: enhanced Memory for Vocal Melodies. Psychol. Sci. 23, 1074–1078.
Wen, Y., Nie, X., Wu, D., Liu, H., Zhang, P., Lu, X., 2014. Amusia and cognitive deficits in schizophrenia: is there a relationship? Schizophr. Res. 157, 60–62.

Please cite this article as: Weisgerber, A., et al., Facial, vocal and musical emotion recognition is altered in paranoid schizophrenic patients. Psychiatry Research (2015), http://dx.doi.org/10.1016/j.psychres.2015.07.042