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Accuracy and intensity of posed emotional expressions in unmedicated schizophrenia patients: Vocal and facial channels

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Abstract

This study investigated the ability of schizophrenia patients to volitionally display various emotional expressions. Accuracy and intensity of facial and vocal emotional expression were rated in 26 unmedicated male schizophrenia patients and 20 non-patient male controls while posing emotional facial and vocal expressions. Results indicate that schizophrenia patients, compared to non-patient controls, had deficits in their ability to portray some, but not all, emotions. Accuracy and intensity of posed facial and vocal expressions were inversely correlated with negative symptoms in the patient group. We conclude that observable flattened affect in schizophrenia during posed expression is not evident across all emotions. Furthermore, substantial disruption in the ability to portray posed emotions may be largely driven by the presence of negative symptoms.

Keywords: Posed emotion; Schizophrenia; Emotional expression; Flat affect; Negative symptoms

1. Introduction

Research and clinical reports indicate that schizophrenia is a disorder associated with affective deficits, e.g., anhedonia, avolition, flat affect. In particular, diminished facial expression, (i.e. flat affect), is a fundamental symptom of the disease; indicative of poor prognosis (Fenton and McGlashan, 1991); temporally stable (Putnam and Harvey, 2000); and associated with chronicity (Carpenter and Strauss, 1991). Facial flat affect has been identified in schizophrenia using the EMFACS coding system (Krause et al., 1989), the FACES coding system (Kring et al., 1993; Kring and Neale, 1996; Kring and Earnst, 1999), more subjective rating systems (Pansa-Henderson et al., 1982; Martin et al., 1990), as well as with electromyographic recording (Kring et al., 1999; Kring and Earnst, 2003). In addition, diminished affective expression has been found in the speech of schizophrenia patients as measured by acoustical analyses of speech prosody (Alpert and Anderson, 1977; Andreasen et al., 1981; Levin et al., 1985; Alpert et al., 1989) as well as by judges' ratings of emotion (Abrams and Taylor, 1978; Andreasen, 1979).

Accumulated evidence indicates that facial expressivity and emotional experience are often dissociated in schizophrenia; therefore, flat affect in schizophrenia does not necessarily represent a reduction in emotional experience. Several studies have found that schizophrenia

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patients displayed less facial expressivity than non-patient controls while watching affect-eliciting films, yet reported normal levels of emotion (Berenbaum and Oltmanns, 1992; Kring et al., 1993; Kring and Neale, 1996; Kring and Earnst, 1999). This finding of normal emotional experience is further supported by studies using emotion-modulated startle where the startle response amplitude of schizophrenia patients did not differ from healthy controls when presented with affect-eliciting stimuli (Schlenker et al., 1995; Curtis et al., 1999). Dissociations have also been found in the vocal realm where a group of schizophrenia patients, in contrast to patients with depression, demonstrated lower levels of vocal positive affect, as indexed by vocal cues. Additionally, the schizophrenic group displayed higher levels of negative affect, indexed by corrugator muscle movement. However, this study found no group differences in self-reported affect (Sison et al., 1996).

In addition to diminished spontaneous facial affective display, schizophrenia patients have demonstrated diminished facial and vocal activity when posing emotional expressions. Using only verbal commands and only measuring accuracy, Gottheil and colleagues (1976) found that medicated schizophrenia patients were less accurate than non-patient controls in posing some emotions (i.e. anger and sadness), but not others (i.e. surprise, fear, or joy). Several studies have provided verbal and pictorial instructions separately (Braun et al., 1991; Gaebel and Wölwer, 1992; Yecker et al., 1999; Trémeau et al., 2005) and have reported diminished intensity (Yecker et al., 1999; Trémeau et al., 2005) and accuracy in posed displays (Gaebel and Wölwer, 1992; Trémeau et al., 2005). Another study reported schizophrenia patients' posed expressions to be less accurate but only when cued by verbal command (Braun et al., 1991). Using only verbal cues but measuring both intensity and accuracy simultaneously, Borod and colleagues (1989) found that medicated patients were less accurate and intense in their posed facial expressions. Vocally, schizophrenia patients have also been found to be both less intense and less accurate (Levin et al., 1985; Borod et al., 1989; Murphy and Cutting, 1990).

There are several inconsistencies in the studies of posed emotional expression in schizophrenia that make the data difficult to interpret. One issue is that often the participants have been on neuroleptic medication that may have affected performance on these tasks. Neuroleptic medication likely influences symptom presentation as well as facial and vocal emotional display. Furthermore, studies have used different induction methods (verbal commands and pictorial presentation) and have rarely (only Borod et al., 1989, with 6 schizophrenia patients) measured accuracy and intensity in both channels (vocal and facial). The ability to pose facial and vocal expressions has been found to be positively related in non-patient populations (Zaidel and Mehrabian, 1969; Cunningham, 1977), but it is not known if these two channels are related in schizophrenia populations. Additionally, the degree of negative symptoms may affect the ability to pose emotional expression, and this has not been adequately investigated in previous studies.

If, in addition to the diminished activity found in spontaneous expression, schizophrenia patients' posed expressions are found to be less expressive, this indicate that the symptom of flat affect is driven by an impairment of the ability to volitionally portray emotions—that is, a skill or neuromotor deficit (Dworkin et al., 1996), rather than a deficiency in the neural and behavioral systems that underlie emotional experience. This would be consistent with emotion research in schizophrenia where a dissociation between emotional display and experience has been found. That is, reduced emotional display has not been found to be reflective of reduced emotional experience.

As negative symptoms are largely affective deficit symptoms, it is expected that there will be relationships between negative symptoms and the intensity and accuracy of posed emotional expression. Furthermore, it is expected that flat affect will specifically be related to posed expression as both share the common substrate of emotional expression.

Research on the relationship between the ability to encode facial and vocal cues has shown that the two skills are positively related in non-patient populations (Zaidel and Mehrabian, 1969; Zuckerman et al., 1975, 1978; Cunningham, 1977). This suggests that there is a nonspecific encoding factor which accounts for the communication of affect in more than one channel. Therefore, failure to find associations between accuracy and intensity and between the vocal and facial channels may indicate a disruption in the constellation of affective communication skills.

The present study sought to investigate posed facial and vocal emotional expressions in unmedicated schizophrenia patients and non-patient controls. Accuracy and intensity of emotional expression were measured simultaneously in the face and in the voice. Negative symptoms were measured in the patient group and related to the accuracy and intensity of the posed expressions. To our knowledge, this is the first study to measure accuracy and intensity in both expressive channels in an unmedicated group of schizophrenic individuals.

2. Methods

2.1. Participants

Twenty-six unmedicated male schizophrenia inpatients selected from Mt. Sinai Medical Center and the Bronx Veteran's Administration Medical Center and 20 non-patient male controls recruited from the nonprofessional staff at the Stony Brook University participated in this study. Participants were part of a larger study examining flat affect in unmedicated schizophrenia (see Kring and Neale, 1996). Only males were studied as it was not feasible to recruit female participants in a Veteran's Administration Medical Center setting. Diagnoses were derived from the standard research protocol (Keefe et al., 1987), which included the Schedule for Affective Disorders and Schizophrenia (SADS; Endicott and Spitzer, 1978) conducted by trained interviewers who arrived at a consensus diagnosis (Kappa=0.87). For those who had not yet completed the standard diagnostic workup ($n=2$), diagnoses were obtained via chart review by one member of our research group to ensure patients met diagnostic criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Revised, 3rd edition*. Participants with a history of head trauma, severe alcohol or drug abuse, or known neurological disease were excluded from the study. Additionally, non-patient participants were excluded if they had a positive personal or family history of psychiatric illness. Schizophrenia patients with evidence of tardive dyskinesia were excluded based on scores on the Abnormal Involuntary Movement Scale (AIMS; Guy, 1976). Participant groups did not significantly differ in age or ethnicity; most of the sample was Caucasian (see Table 1). The members of the control group had more education and were more often married or divorced, in contrast to being single. Demographic data were missing for one control participant. Importantly, neither education nor marital status was related to either accuracy or intensity of facial and vocal expressions. The schizophrenia patients were a chronic sample with severe negative symptoms, as indicated by the Schedule for Negative Symptoms (SANS; Andreasen, 1989) and numerous and lengthy hospitalizations.

Because these patients were involved in medication protocols at the Bronx Veteran's Administration Medical Center, they were all medication-free for at least 2 weeks prior to testing (number of days drug free ($M=18.60$, S.D.=4.73). This strengthened the validity of the results of the current study as affective flattening can be confused with side effects for neuroleptic medication (e.g. akinesia). Serum neuroleptic levels were analyzed to confirm drug-free status. Patients who had received depot neuroleptics were excluded as they often lead to the maintenance of plasma drug levels for several months following their discontinuation (Wistedt et al., 1981).

2.2. Procedure

Approval for the study was obtained from each institution and informed consent was received from every study participant.

Table 1
Demographics and clinical characteristics

Variable	Schizophrenia ($n=26$)		Controls ($n=20$)		t	χ^2	P
	n (%)	$\bar{X}$ (S.D.)	n (%)	$\bar{X}$ (S.D.)			
Age		40.23 (10.16)		36.95 (12.62)	0.97		–
Ethnicity						2.78	–
Caucasian	16 (62%)		16 (80%)				
African American	4 (15%)		2 (10%)				
Latino	6 (23%)		2 (10%)				
Education		11.42 (2.96)		12.89 (1.41)	2.0		0.05
Marital status						17.71	<0.01
Single	20 (77%)		8 (40%)				
Married			7 (35%)				
Divorced			5 (25%)				
Hospitalization							
Frequency		8.43× (9.09)					
Total months		98.80 m (232.27 d)					
SANS subscales:							
SANS flat affect		12.12 (6.8)					
SANS alogia		5.36 (3.76)					
SANS avolition		10.84 (4.32)					
SANS anhedonia		13.05 (6.01)					
SANS total		10.34 (4.55)					

2.2.1. Posed facial expression

Participants were asked to portray facial expressions cued by pictures of actors exhibiting six target emotions: happy, angry, sad, surprised, afraid, and disgusted (Ekman and Friesen, 1975). These emotions were chosen based on findings by Ekman and colleagues where they demonstrated the primacy of at least six emotional facial expressions which are widely transcultural (see Ekman and Oster, 1979). The exemplars of the six emotions were highly recognizable based on the normative data provided by Ekman and Friesen. The participants were instructed verbally at the same time they were presented with a photograph (e.g. "Look happy like the woman in the picture."). After a practice expression, participants posed each facial expression twice—for a total of 12 stimuli. The photos were presented to the participants in a random order that did not vary between subjects, and their facial expressions were recorded with a videotape recorder.

2.2.2. Posed vocal expression

Participants were asked to read a series of 16 sentences in different emotional tones. Four sentences of neutral content (e.g., "The boy went to the store.") adapted from Tucker et al. (1977) were printed on 5″ by 7″ index cards with one of three emotions (happy, sad, angry) and "indifferent" (i.e. neutral) printed below the sentence indicating that the sentence was to be read in that tone. They were also instructed verbally. Each of the four sentences was printed in black ink on four different cards (one for each emotion), totaling 16 different stimuli. Each emotion was defined prior to the testing, and participants were given a practice sentence. For the testing phase, the cards were presented to the participants in fixed random order, and their speech was recorded with an audiocassette recorder. The posed vocal task is likely more difficult than the posed facial task as the participants do not have stimuli to imitate; they are only asked to simulate. Therefore, we also included a neutral condition (i.e. "indifferent") to ensure that the groups did not differ in their ability to follow the verbal instructions.

2.2.3. Ratings of vocal and facial expressions

All sentences and facial expressions were randomized across participants and emotions and edited onto a master tape for rating, thus the raters were blind to diagnosis and target emotion. Raters rated the emotional category (i.e. accuracy) and the intensity of the emotional tone of each sentence and facial expression. For the accuracy ratings, eight raters (a different group for each channel) were instructed to identify the affective category of each of the sentences and facial expressions. After watching a facial expression, raters chose between the six target emotions. After listening to a vocal expression (i.e. a sentence), raters chose between the 4 target emotions. A "hit" was designated if the rater identified the correct emotion. Proportions of correct "hits" were computed for each trial and each participant.

Two raters completed all of the intensity ratings using a 4-point scale, ranging from 0 (no intensity or no emotion portrayed) to 3 (extreme intensity). Intensity was defined as "how much emotion the participant expressed". Intensity was rated independently of accuracy. Thus, if a participant displayed an intense but inaccurate emotion, this would be rated high on intensity but overall accuracy would be diminished. If a participant was judged to be presenting no emotion, then his/her facial expression was rated a "0" on intensity.

2.2.4. Raters' training and reliability

The training and reliability for the rating of posed affective expressions on accuracy and intensity were conducted separately with a different set of raters for each; the procedures were identical. Two training sessions occurred. In the first, raters met to rate 24 (2 of each of the 6 emotion categories for each group) posed facial expressions, and in the second, raters rated 16 (2 of each of the 4 emotion categories for each group) posed vocal expressions. The posed expressions were selected to represent an equal number of emotions from each group and various points on the intensity rating scale. After the presentation of each expression, raters rated its intensity or accuracy, and then individuals discussed the manner at which they reached their decision. The group then decided on a series of objective criteria that could be used to rate the posed expressions. Reliability ratings were then conducted in two sessions where raters rated the 20 facial and 20 vocal expressions (facial and vocal expressions were rated in separate sessions) without discussion. These were new expressions that were not included in the previous training sessions. Reliabilities for accuracy and intensity were computed separately from these 20 expressions. Cohen's kappa was used for the reliability ratings with only two ratings entered per expression per rater ("hit" or "miss") and then averaged across the posed and vocal channels (Kappa = 0.80). Intraclass Correlations (Shrout and Fleiss, 1979; equation number 2) were computed for the intensity ratings scored by the two judges and were also averaged across the posed and vocal channels (ICC = 0.83).

2.2.5. Negative symptom ratings

Schizophrenia patients were rated with the SANS (Andreasen, 1989) at the Bronx Veterans Administrative

Medical Center, where they were inpatients involved in research protocols. These interviews were completed while patients were off-medication and were done within 2 weeks of testing. Inter-rater reliability (Kappa) for the SANS at this institution was 0.80.

2.3. Statistical analyses

Prior to analysis, all dependent variables were examined for accuracy of data entry, missing values, outliers, and fit between their distributions and the assumptions of multivariate and univariate analysis. Except where transformations are noted, all variables were within acceptable limits ($P<0.01$) for skewness, kurtosis, and outliers. The data representing the proportion of correct "hits" were transformed with an arcsine transformation as recommended by Cohen and Cohen (1983) for analysis of proportions. Two of the variables (afraid and angry) remained skewed so these variables were transformed using a square root. Between-group analyses were conducted using Repeated Measures MANOVAs with Group (patient, control) as the between-subjects factor and Emotion (afraid, angry, disgusted, happy, sad, surprised for the facial analyses; and angry, happy, sad, and indifferent, i.e. neutral, for the vocal analyses) as the within-subjects factor.

3. Results

Facial accuracy. There was a significant main effect of Emotion, $F(5,35)=12.65$, $P<0.001$, and a significant Group × Emotion interaction, $F(5,35)=4.17$, $P<0.01$ (see Table 2). Separate univariate ANOVAs revealed significant group differences for Surprise, $F(1,43)=6.8$, $P<0.05$, and Sadness, $F(1,41)=5.44$, $P<0.05$. For both Sadness and Surprise, the posed expressions of the schizophrenia patients were less accurate than the controls.

Table 2
Posed facial emotion accuracy (proportion correct)

Variable	Schizophrenic patients			Normal controls		
	$\bar{X}$	S.D.	n	$\bar{X}$	S.D.	n
Disgust	0.55	0.26	25	0.43	0.27	19
Happiness	0.70	0.31	26		0.810.24	18
Sadness*	0.48	0.27	25		0.660.22	18
Surprise*	0.47	0.30	26		0.680.24	19
Fear	0.26	0.25	26		0.390.24	18
Anger	0.44	0.26	25		0.380.23	16

*Univariate ANOVA, $P<0.05$.

Table 3
Posed facial emotion intensity

Variable	Schizophrenic patients			Normal controls		
	$\bar{X}$	S.D.	n	$\bar{X}$	S.D.	n
Disgust	2.00	0.44	25	1.81	0.35	19
Happiness	1.81	0.42	26		1.740.29	18
Sadness	1.52	0.46	25		1.440.43	18
Surprise*	1.74	0.54	26		2.110.52	19
Fear	1.75	0.52	26		1.750.53	18
Anger	1.74	0.54	25		1.560.34	16

*Univariate ANOVA, $P<0.05$.

Facial intensity. Results indicated a significant main effect of Emotion, $F(5,32)=8.70$, $P<0.001$, and a significant Group × Emotion interaction, $F(5,32)=3.21$, $P<0.01$ (see Table 3). Separate univariate ANOVAs revealed a significant group difference for Surprise, $F(1,43)=4.27$, $P<0.05$, with the expressions of schizophrenia patients judged as less intense than the controls' expressions.

Vocal accuracy. As with the facial accuracy data, these proportions were transformed with an arcsine transformation. There were significant main effects of Group, $F(1,44)=13.59$, $P<0.001$, and Emotion, $F(3,42)=10.12$, $P<0.001$ (see Table 4). Although this interaction was not significant, we followed up with univariate ANOVAs as our initial hypotheses did not reflect the position that schizophrenic patients would demonstrate a general posing deficit across all emotions. Therefore, these comparisons were planned. Separate univariate ANOVAs revealed significant group differences for Anger, $F(1,44)=7.82$, $P<0.01$, and Happiness, $F(1,44)=4.96$, $P<0.05$. In both cases, the vocal expressions of the schizophrenia patients were less accurate than the control group. Both groups were least accurate in their display of Indifference, range of $t(45)=2.85$–4.79, $P's<0.01$, but the between-group difference was not significant.

Vocal intensity. There was a significant main effect of Emotion, $F(3,42)=17.35$, $P<0.001$, and a significant Group × Emotion interaction, $F(3,42)=3.05$, $P<0.05$ (see Table 5). Separate univariate ANOVAs revealed no significant group differences.

3.1. Correlations between posed accuracy and intensity[1]

In order to reduce the number of analyses, the individual emotions were collapsed and average emotion was analyzed. Uncorrected Pearson $r's$ were

[1] All correlations using vocal variables were conducted without Indifference as that is by definition, "no emotion".

Table 4
Posed vocal emotion accuracy (proportion correct)

Variable	Schizophrenic patients			Normal controls		
	$\bar{X}$	S.D.	*n*	$\bar{X}$	S.D.	*n*
Happiness*	0.33	0.29	26		0.520.23	20
Sadness	0.46	0.26	26		0.560.26	20
Anger**	0.42	0.27	26		0.630.17	20
Indifference	0.27	0.14	26		0.320.22	20

*Univariate ANOVA, $P<0.05$.
**Univariate ANOVA, $P<0.01$.

computed. Posed facial accuracy and intensity were significantly correlated for both the schizophrenia and control groups (see Table 6). Posed vocal accuracy and intensity were also significantly correlated for both the schizophrenia group and control groups.

3.2. Correlations between posed vocal and facial expressivity

Correlations were computed between facial and vocal accuracy and between facial and vocal intensity separately for both groups. For the schizophrenia group, posed facial accuracy and posed vocal accuracy were significantly correlated, but not for the control group (see Table 6). The correlations were not significantly different between groups. However, there was a significant correlation between posed facial intensity and posed vocal intensity for both groups.

3.3. Correlations between negative symptoms and posed expressions for the schizophrenia group

Significant correlations were found between SANS flat affect and posed facial accuracy and posed facial intensity but not for posed vocal accuracy or posed vocal intensity. For the total SANS, significant correlations were found between posed facial intensity and a trend for posed vocal accuracy, but not for posed facial accuracy or posed vocal intensity. Thus, less accuracy and intensity in posed facial expressions was associated with greater ratings of flat affect and negative symptoms (Table 6).

Table 5
Posed vocal emotion intensity

Variable	Schizophrenic patients			Normal controls		
	$\bar{X}$	S.D.	*n*	$\bar{X}$	S.D.	*n*
Happiness	1.37	0.66	26		1.660.57	20
Sadness	1.25	0.52	26		1.220.50	20
Anger	1.53	0.57	26		1.590.59	20
Indifference	1.03	0.43	26		0.860.57	20

Table 6
Pearson correlations between posed accuracy, intensity, and negative symptoms

	Facial accuracy	Facial intensity	Vocal accuracy	Vocal intensity
Facial accuracy				
Schizophrenia	–	0.61***	0.45*	–
Controls	–	0.63***	–	–
Facial intensity				
Schizophrenia		–	–	0.44*
Controls		–	–	0.52**
Vocal accuracy				
Schizophrenia			–	0.77***
Controls			–	0.69***
Vocal intensity				
Schizophrenia				–
Controls				–
SANS total				
Schizophrenia	–	−0.54*	−0.41†	–
SANS flat affect				
Schizophrenia	−0.47*	−0.60**	–	–

*$P<0.05$, **$P<0.01$, ***$P<0.001$, †$P=0.08$.

3.4. Correlations between measures of chronicity and posed expressions and negative symptoms for the schizophrenia group

Using the number of months in the hospital, lifetime, as a measure of chronicity, we found no significant correlations between chronicity and any of our posed emotion measures. However, chronicity was significantly correlated with both total SANS ($r=0.66$, $P<0.001$) and the SANS flat affect subscale ($r=0.67$, $P<0.001$).

4. Discussion

Overall, schizophrenia patients did not exhibit uniform impairment in their ability to pose emotional expressions. When specific emotions were examined, group differences did emerge. The control group more accurately portrayed facial sadness and surprise. There were no significant group differences in the facial posing of disgust, happiness, fear, or anger. One explanation for this could be that disgust and happiness are less difficult emotions to pose. It was difficult for both groups to portray fear and anger, and this is likely due to

the infrequency with which these emotion naturally occur.

The only group difference in posed facial intensity was found with surprise where the control group was more intense. As intensity requires more facial movement, our findings are similar to those of Berenbaum (1992) who found no differences in the amount of facial movements displayed by schizophrenia, depressed, and control participants on a posed emotion task.

Schizophrenia patients were less accurate in their vocal portrayal of happiness and anger, but no significant group differences were found for indifference or sadness. However, it should be noted that there was not a significant interaction between Group × Emotion. As posing vocal emotion was found to be more difficult for both groups, perhaps the emergence of greater group differences in the vocal channel is driven by the increased difficulty of this task. The lack of significant group differences for sadness and indifference appears to be due to the poor performance of the control group, rather than a specific deficit of the schizophrenia group. There were no group differences found in the intensity of vocal expressions.

These results are somewhat inconsistent with past studies that have reported reduced accuracy and intensity of posed facial emotional display in schizophrenia. Several factors distinguish this study and may pertain to this apparent inconsistency. Most notably, the schizophrenia patients in this study were not medicated. Gaebel and Wölwer (1992) tested patients before they were put on medication as well as after 4 weeks on medication. However, they combined both of these assessments in their analysis of posed facial expression. Trémeau et al. (2005) assessed a subset (15 out of 58) of their sample twice, while not taking antipsychotic medication and while taking antipsychotic medication. They found that this subset of patients did not demonstrate any changes in study variables between these two assessments. Although this is relevant information, it is not clear that this subset was randomly selected as these were patients that were either recently admitted or in a drug-free phase of another study. Therefore, these patients could have been less chronic and/or not yet exhibiting the affective flattening symptoms associated with antipsychotic medication as the duration of time on the medication was too short. Another distinctive feature of this study is that the participants were cued visually and verbally at the same time for both the posed facial and vocal tasks. Other studies have kept these cues as separate tasks.

The strong correlations between intensity and accuracy and also between facial and vocal channels indicate associations between these different facets of emotion encoding for both groups of participants. Therefore, these data do not indicate a disruption in the cohesion of emotional communication skills for schizophrenia patients. For both groups, these results indicate that it is easier to accurately pose facial and vocal emotion when it is displayed at higher intensities. Additionally, these findings are in agreement with posed emotion studies using non-patient samples that have reported significant positive correlations between vocal accuracy and facial accuracy (Zaidel and Mehrabian, 1969; Cunningham, 1977) as well as with Zuckerman et al. (1975) who concluded that a general affective communication factor existed in their non-patient sample.

These data do not wholly support the neuromotor dysfunction model (Dworkin et al., 1996) where it is proposed that diminished emotional display in schizophrenia may be partially accounted for by neuromotor dysfunction. These data indicate that the emotional expressions of schizophrenia patients are not necessarily blunted when they are asked to volitionally portray emotions as there were few significant differences found between the control group and the schizophrenia group in the intensity of posed expressions. Although schizophrenia patients exhibited some impairments in their accuracy of display for facial and vocal posed emotional expressions, these impairments did not occur across all categories of emotion nor consistently in specific emotions across facial and vocal channels. The neuromotor dysfunction model would predict dysfunction in the schizophrenia group across emotions and channels. It may be that the neuromotor dysfunction model is applicable to a subset of patients with schizophrenia characterized by more extreme negative symptoms. This was demonstrated in this data set by the more pronounced impairments in both accuracy and intensity in negative and positive emotions in both the facial and vocal channels for the schizophrenic group with higher SANS global scores.

A potential model to explain these data is offered by Kring and Bachorowski (1999) who suggest that schizophrenia patients are spontaneously expressing emotion facially, but not at an overtly observable level. This model suggests that schizophrenia patients have a different threshold for producing observable emotional displays and only when stimuli are of sufficient intensity, would patients' expressive behaviors be observable (Ekman, 1992). This is supported by findings where schizophrenia patients demonstrate similar or greater covert expressive behavior (as measured by EMG) in response to emotion-eliciting films (Mattes

et al., 1995), pictures of facial expressions (Kring et al., 1999), and while discussing pleasant and unpleasant events (Mattes et al., 1995). As the underlying psychological constituents of emotional expression and emotional recognition undoubtedly overlap, it is relevant to this discussion that the ability of schizophrenia patients to accurately recognize emotions has also been found to be more accurate when more intense affective stimuli are used (Kohler et al., 2003). In the current study, the participants were cued to generate very intense emotional expressions. If they were cued to generate less intense expressions, perhaps the patients' posed expressions would have been consistently less accurate and intense than the control group.

A related hypothesis is that a subset of schizophrenic patients with pronounced negative symptoms more consistently demonstrate impairments posing emotions than do other patients with schizophrenia, regardless of the level of intensity. This is consistent with the results of this study and others that have investigated chronic schizophrenia samples (Trémeau et al., 2005) where more severe negative symptoms ratings were found to be associated with impaired accuracy and lower intensity of posed emotional expressions. Although this impairment could be related to volition or chronicity rather than a more specific affective deficit, we did not find any significant correlations between these variables and measures of posed emotional expression. It is more likely that these results indicate that blunted affective display is a key element of negative symptoms. Another study (Gaebel and Wölwer, 1992) did not find an association between voluntary facial expression and SANS scores. The sample of this study was comprised of "acute schizophrenics", half of which had never received medication previously. In contrast, the sample of the present study was quite chronic and likely had more pronounced negative symptoms. This relationship with negative symptoms could explain the inconsistencies in the data regarding posed emotional expression in schizophrenia as some of these studies examined schizophrenia patients with negative symptoms (e.g., Borod et al., 1989; Yecker et al., 1999) and samples from other studies were unselected (e.g., Sison et al., 1996).

This study is the only one to our knowledge that has examined both accuracy and intensity of posed facial and vocal expressivity in a group of unmedicated schizophrenia patients. However, it is important to note some limitations of this study. The patient and control samples were entirely male, and the patient sample was comprised of patients with a more chronic form of the illness; this could affect the generalizability of these findings. Although patients with tardive dyskinesia were excluded, we had no direct measure of extrapyramidal symptoms and, thus, cannot determine how these may be influencing our results. We have no additional measures of clinical state, other than the SANS scores and the clinical course variables. The cue stimuli were presented in the same order for all subjects, thus introducing a potential confound of carryover effects from the previous emotion. We did not use the same emotion stimuli set for both facial and vocal channels, thus limiting the comparisons between these two channels. The rating method we used was fixed choice; therefore, this could have introduced rating bias. However, using an open-ended approach would have introduced additional and unmeasurable confounds. The raters were intentionally untrained in an effort to obtain a sample of raters that most closely resembled average recipients of affective communication. Although this provided greater external validity, this may have introduced other confounds into our rating system.

The results of this study indicate that schizophrenia is not uniformly associated with an impaired ability to accurately and intensely display posed facial and vocal emotional expressions. Rather, it may be that there is a subgroup of individuals with schizophrenia who are characterized by pronounced negative symptoms and deficits in volitional emotional display. There are a number of clinical implications. First, these findings suggest that patients are able to contract the facial muscles associated with emotional expressions, at least on command. Thus, the building blocks of a psychosocial intervention aimed at increasing expressive behavior may do well to begin with improving schizophrenia patient's accuracy at posing particular emotions, and then comparing these with spontaneous displays. Identifying subgroups within schizophrenia may allow for a more sophisticated and perhaps effective approach to treatment whereby the specific pathophysiological mechanisms of each clinical dimension (i.e. positive, negative, cognitive, and affective) are targeted and selectively treated.

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