FACIAL EMOTION AND ORIENTATION-MATCHING IN SCHIZOPHRENIA PATIENTS
AND NORMAL CONTROLS

MIKISHA LYN DOOP

Thesis under the direction of Professor Sohee Park

Schizophrenia (SZ) patients exhibit deficits in recognition and identification of facial emotional expressions but it is unclear whether these deficits result from abnormal affective processing or an impaired ability to process complex visual stimuli such as faces. SZ and matched healthy controls (CO) participated in two computerized visual matching tasks (facial emotional expression and orientation). Accuracy and reaction time were recorded. Clinical symptoms were also assessed in the patients. SZ were less accurate on both facial emotion and orientation matching tasks compared with CO but there was no diagnosis-by-task interaction. Clinical symptoms of SZ were associated with deficits on the matching tasks and social functioning was correlated with emotion matching errors across both groups. SZ have general deficits in processing of faces, which is in turn associated with worse symptoms and reduced social functioning.

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Mikisha Lyn Doop

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To my father, James Albert Doop, and my mother, Frankie Ann Burchfiel, for learning to love

me no matter what.

To Professor Sohee Park, because plain old acknowledgements just won't cut it.

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CHAPTER I

INTRODUCTION

Past research indicates that both vocal and facial emotion recognition is impaired in

schizophrenia (Walker et al., 1984; Feinberg et al., 1986; Borod et al., 1993; Archer et al., 1994;

Mandal et al., 1998; Edwards et al., 2001; Baudouin et al., 2002; Hooker & Park, 2002), and that

this deficit is most likely a trait-like feature of the illness (Addington, et al., 2008; Exner et al.,

2004; Kline et al., 1992; Poole et al., 2000; Salem et al., 1996; Schneider et al., 1995).

Schizophrenics (SZ) perform worse than control subjects (CO) on tasks that require emotion

identification or discrimination (Walker et al., 1980; Salem et al, 1996) but such deficits may

stem from a generalized deficit in face processing. Indeed evidence suggests that there is no

specific deficit in emotion perception in SZ (Kerr & Neale, 1993) but that they may have

generalized deficits in processing of faces (Salem et al., 1996) and face processing deficits may

be related to cognitive deficits in schizophrenia (Bryson et al., 1997; Schneider et al., 1995;

Addington & Addington, 1998; Kholer et al., 2000).

The relationships among symptom severity, emotion processing, and face processing have

been investigated but are not clearly understood. Some studies have found a relationship

between positive symptoms and face processing (Martin et al., 2005; Kholer et al., 2000;

Baudouin et al., 2002; Schneider et al., 1995); other studies have found a relationship between

negative symptoms and face processing (Suslow et al., 2003b; Mueser et al, 1996; Kholer et al.,

2000), and yet other studies have found no relationship between symptoms and face processing

(Salem et al., 1996; Borod et al., 1993; Muzekari & Bates, 1977). Nevertheless, accurate processing of facial stimuli seems to have implications for social functioning in schizophrenia (Hooker & Park, 2002; Suslow et al., 2003a).

The goal of the present study was to extend previous findings of facial processing deficits of schizophrenia in relation to social functions using two simple matching tasks with no language or working memory demands which may have confounded past studies.

CHAPTER II

METHODS

Participants

Twenty-two healthy CO (12 females) were recruited via advertisements. CO were

screened for history of psychiatric illness, head injury, epilepsy, and drug use. Sixteen (5

females) individuals who met the DSM-IV criteria for schizophrenia or schizoaffective disorder

(13 schizophrenia, 3 schizoaffective) were recruited from an outpatient-clinic. All schizophrenic

and schizoaffective subjects were chronically ill (mean years of illness = 13.4, S.D. = 7.4) and

were out patient subjects. Exclusion criteria for SZ were multiple diagnoses, head injury,

epilepsy, or current drug abuse. All SZ were taking atypical antipsychotics. Demographic

information is presented in Table 1. All participants gave written informed consent approved by

the Vanderbilt University Institutional Review Board and were compensated.

There were no group differences in age ($F_{(1,36)} = 1.41$, p = n.s.), education ($F_{(1,36)}$=

0.41, p = n.s.), estimated full-scale IQ ($F_{(1,34)} = 0.92$, p = n.s.) and handedness measured by the

Global Handedness Questionnaire ($F_{(1,36)} = 1.96$, p = n.s.). There was a significant difference

in Zigler Score of Social Functioning ($F_{(1,36)} = 26.59$, p <0.0001) between groups. IQ data

were missing for 2 CO subjects but since the education level was matched, it is unlikely that the

two groups differed in general cognitive ability.

Table 1: Demographic Data

	Control Subjects (n = 22)	Schizophrenic Subjects (n = 16)
Education (years)	13.2 (1.9)[A]	12.8 (2.0)
Age	34.5 (11.2)	38.8 (10.2)
Full Scale I.Q.[B]	95.4 (14.5)	100.0 (14.0)
BPRS	N/A	25.5 (13.7)
SANS	N/A	28.9 (19.3)
SAPS	N/A	26.3 (22.8)
SPQ	16.5 (8.0)	N/A
Global Handedness Score[C]	80.3 (35.7)	58.3 (56.7)
CPZ Equivalent[D]	N/A	283.9 (98.3)
Illness Duration	N/A	13.4 (7.4)
Zigler Score[E]	5.0 (1.9)	2.2 (1.1)

[A] Mean (standard deviation)
[B]Wechsler Adult Inteligence Scale - Revised (Wechsler, D., 1981) and Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler et al., 1999).
[C] Global Handedness Questionnaire (Ransil, B., & Schachter, S., 1994)
[D] Chlorpromazine dose equivalent (in milligrams per day; Woods, 2003)
[E]Zigler Score of Social Functioning (Zigler, E., & Levine, J., 1981)

All tasks were performed on an iMac computer (screen size 28.75 x 21.25cm). Subjects were seated 40 cm from the screen. Face stimuli were selected from the Karolinska Directed Emotional Faces (KDEF, Lundqvist et al., 1998). Calvo and Lundqvist (2008) conducted a study investigating valences and accuracy of identification using the KDEF stimuli. This study showed that happy faces were identified more accurately than other faces. However, fearful faces were identified less accurately than other faces. Please see www.psychonomic.org/archive for norms for each face and expression regarding identification accuracy, errors, and reaction times. Emotions used were neutral, happy, sad, fearful, and angry. All subjects had normal or corrected-to-normal vision. There were 20 trials per task and the order of task presentation was counterbalanced across subjects. For both tasks, accuracy and reaction times (RT) were recorded.

Emotion Matching

Subjects were asked to look at a fixation dot at the center of the screen. When they were ready to begin a trial, they clicked on the fixation dot with the mouse. The screen displayed a target face directly above the fixation dot and 3 different faces below the fixation dot (see Figure 1). Subjects were instructed to select from the face that matched the emotional expression of the target face above the fixation dot.
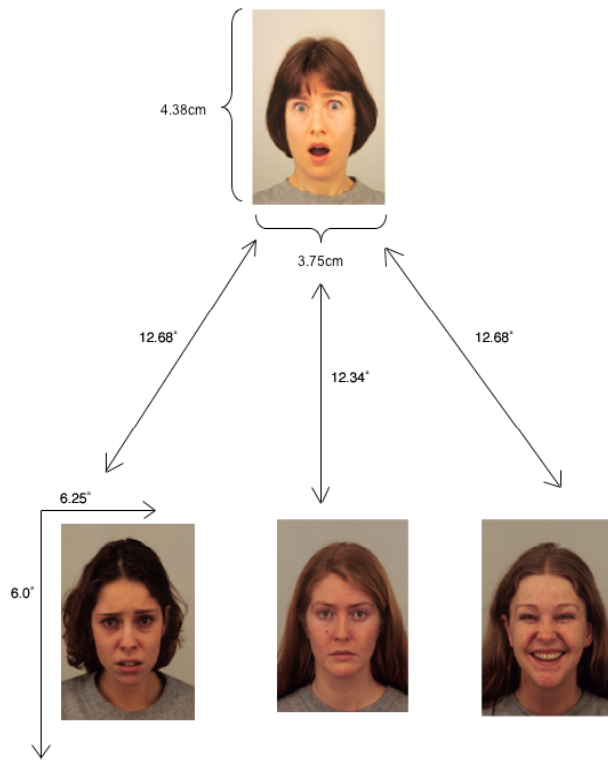
Figure 1: Emotion Matching Design

Facial Orientation-matching

        The procedure was identical to the one described above for the emotion matching task but in this case, subjects were instructed to select the face that matched the orientation of the target face above the fixation dot (see Figure 2).

Figure 2: Facial Orientation Matching Design

Clinical symptoms

Brief Psychiatric Rating Scale (BPRS; Overall & Gorhman, 1962), Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984), and Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1984) were used to assess symptoms.

Schizotypal Personality in Controls
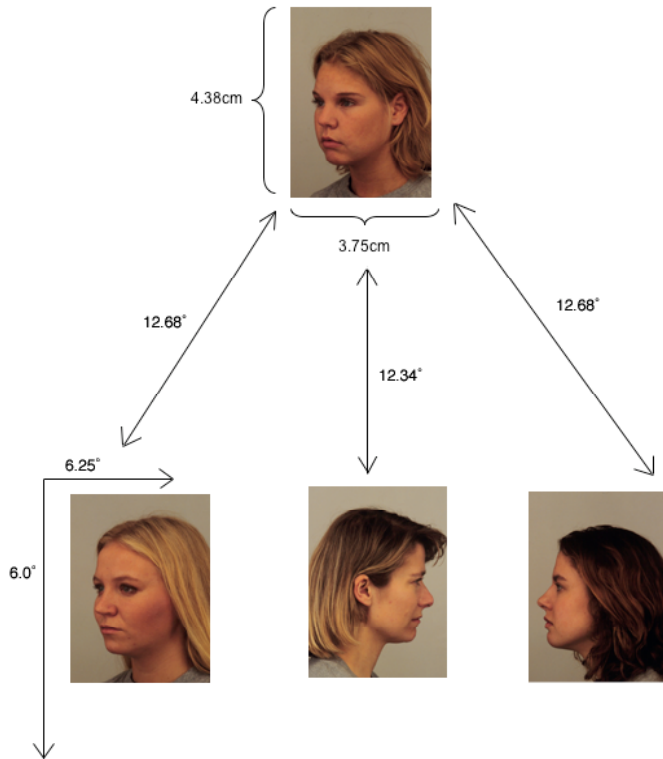
We used the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991), a self-report questionnaire based on DSM-III criteria for schizotypal personality disorder.

Social functioning

The Zigler social competence scale (Zigler & Levine, 1981) was used to estimate social functioning in all participants, using demographic information.

Data Analysis

Repeated measure ANOVA was used to compare the two groups on % correct responses and response times. Fisher's PLSD was used for the post-hoc analysis. Correlations were computed using the Pearson product moment correlation. Cohen's *d* was used to calculate effect sizes.

CHAPTER III

RESULTS

Accuracy

There was a main effect of diagnosis ($F(1,36)=10.10$; $p=0.003$, $r=0.89$). CO (Mean=92.50%; SD=8.46) performed better overall than SZ (Mean=81.41%; SD=20.25). A main effect for task was also found ($F(1,36)=8.82$; $p=0.005$, $r=0.84$). Subjects performed better on the facial orientation task (Mean=92.50%; SD=18.45) than on the emotion-matching task (Mean=83.16%; SD=10.16). There was no significant interaction (see Figure 3).
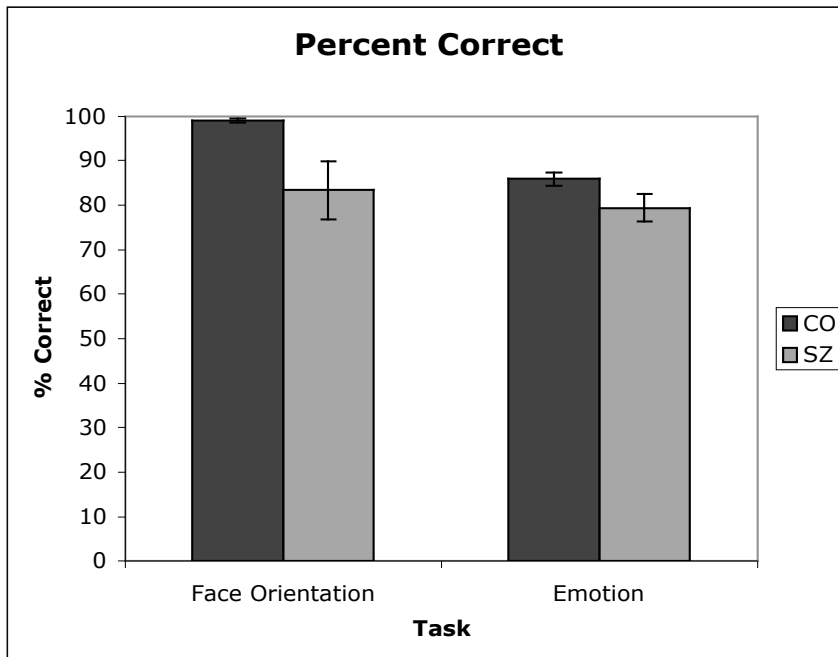
Figure 3: Mean percent correct (bars are standard error)

There was no main effect of diagnosis (F(1,36)=0.22; p=n.s.), but there was a main effect of task type (F(1,36)=20.09; p<0.0001, r= 0.99). Subjects were faster on the face-orientation task (Mean=4723ms; SD=3516) than on the emotion-matching task (Mean =7153ms; SD=2326). There was a trend towards a group-by-task interaction (F(1,36)=4.03, p<0.06, r=0.49). However, post-hoc analyses showed no significant differences in reaction time between groups on either the facial orientation-matching task or the emotion-matching task (see figure 4).

Reaction Time

Figure 4: Mean reaction time in milliseconds (bars are standard error)

Relationships with Social Functioning and Symptomatology

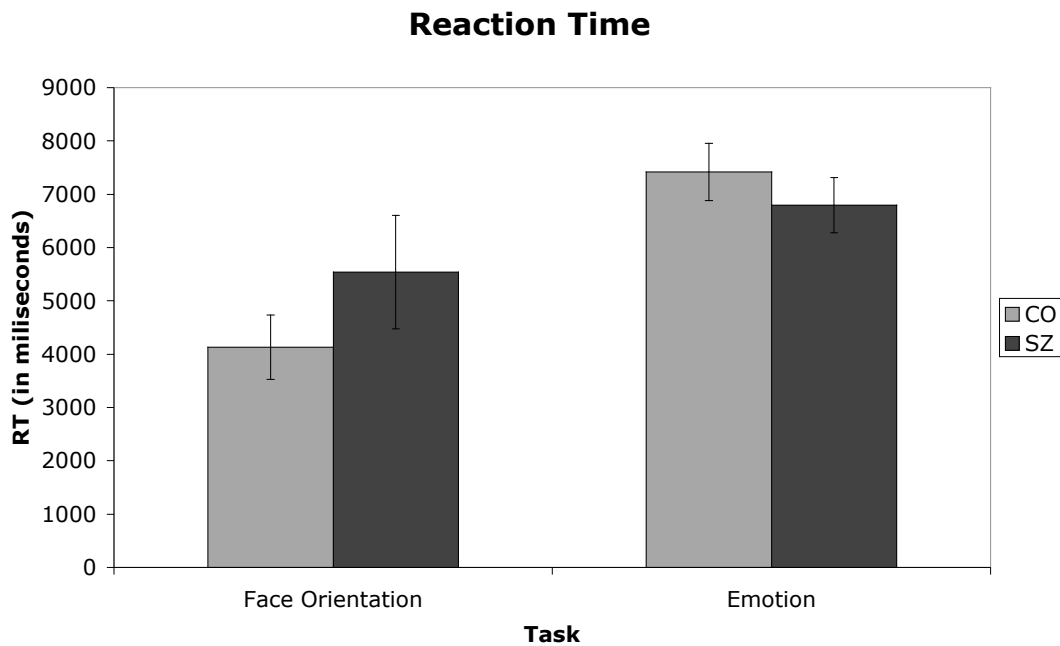Across both groups, Zigler score of social function was positively correlated performance on the emotion-matching task (r = 0.38; p=0.02). Interestingly, there was also a trend for a significant correlation between Zigler score of social functioning and performance on the face-orientation task (r=0.31, p=0.06) suggesting that better performance on face processing in general may be related to better social functioning.

In SZ group, BPRS ratings were negatively correlated with performance on the emotion-matching task (r = -0.57, p = 0.04), suggesting that SZ with more symptoms were less accurate on the emotion-matching task. There was a trend towards a negative correlation between positive symptoms (SAPS) and accuracy on the emotion-matching task (r = -0.52, p = 0.07). There were no significant correlations with negative symptoms and task performance. Illness duration was negatively correlated with performance on the face-orientation task (r = -0.68, p = .07) and positively correlated with RT on the same task (r = 0.74, p = 0.04). Daily medication dose (as measured by the CPZ equivalent) was positively correlated with performance on the face-orientation task (r = 0.53, p = 0.05) and negatively correlated with reaction time on the same task (r = -0.60, p = 0.02). These findings suggest that symptom management is related to the ability to process facial stimuli. In other words, those patients with better face processing ability tend to have fewer symptoms.

CHAPTER IV

DISCUSSION

This study aimed to investigate face processing in SZ while controlling for external

cognitive demands. Face processing was impaired in SZ whether they were asked to match

emotion or orientation. It is interesting to note that while SZ tend to be slower than CO in

general, there was no RT difference between SZ and CO in this study; both groups were faster on

matching orientation than emotion.

Our data suggests that positive symptoms are related to poorer performance on emotion

matching and may be related to a facial processing deficit in general. SZ patients with more

symptoms performed worse on the emotion-matching task, and our data suggest that this finding

may be a function of positive symptoms rather than negative symptoms. In line with this finding,

Pinkham, et al. (2008) found that paranoid schizophrenics showed decreased neural activation in

the right amygdala, fusiform face area, and left ventrolateral prefrontal cortex as compared to

controls on a face processing task. These findings are interesting in that core features of negative

symptoms are deficits of emotion processing, and one would hypothesize a relationship between

negative symptoms and face processing deficits.

This study also underscores the relationship between social functioning and the ability to

process affective facial stimuli. There was a positive correlation between the Zigler score of

social functioning and the ability to correctly process emotional faces across both groups. This is

similar to what Hooker and Park (2002) found in their study. They showed that affect

recognition performance was related to social functioning as measured by the Social Dysfunction Index (Hooker & Park, 2002).

There are several limitations to our study. The sample size is small so we were not able to examine the symptom-face processing relationship comprehensively. Secondly, it is yet to be determined if deficits in face processing are due to a larger overarching perceptual and cognitive deficit. Faces are after all, a class of complex visual stimuli. However, a study on biological motion perception in SZ patients (Kim et al, 2005) indicate that SZ may be selectively impaired in processing biological stimuli (i.e., socially-relevant stimuli such as faces) compared with nonbiological objects. Lastly, the Zigler score of social functioning is more equipped to measure pre-morbid social functioning that current social functioning. This may have influenced our findings when using that measure.

Taken together our findings indicate that SZ have deficits in face processing in general, replicating Salem et al's results (1996) and that face processing deficits may have significant socioaffective consequences for the patients.

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