IMPAIRED RECOGNITION OF GAIT PRESENTED AFFECT IN PATIENTS WITH SCHIZOPHRENIA

By

Joel Stephen Peterman

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Approved:

Dr. Sohee Park

Dr. Andrew Tomarken

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CHAPTER I

INTRODUCTION

Over the past several decades, considerable attention has been paid to schizophrenia patients' abilities to recognize emotional expressions in others. Abnormalities in emotion, such as their expression or identification, have been noted as being part of the clinical picture of schizophrenia since the disorder was first identified (Kraepelin, 1971; Bleuler, 1972). Emotion recognition plays an important role in the ability to engage in social interactions (Hooker & Park, 2002). While research in the area of emotion recognition in schizophrenia has been substantial (for a review see Kohler, Walker, Martin, Healey, & Moberg, 2010), there are still aspects of this process that remain to be elucidated. The current study intends to expand upon the emotion recognition literature by approaching the assessment of emotion recognition by incorporating more ecologically valid stimuli as well as assess whether the intensity of emotional expression affects performance in individuals with schizophrenia.

Individuals with schizophrenia consistently display deficits in the recognition of emotion (Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000; Mueser, Penn, Blanchard, & Bellack, 1997; Muzekari & Bates, 1977). This deficit does not seem to be the result of age, years of education, gender, or medication status (Kline, Smith, & Ellis, 1992; Poole, Tobias, & Vinogradov, 2000; Salem, Kring, & Kerr, 1996; Schneider, Gur, Gur, & Shatsel, 1995). Furthermore, these deficits are present in individuals believed to be at heightened risk for the later development of schizophrenia (Mikhailova, Vladimirova, Iznak, Tsusulkovskaya, & Sushko, 1996) and first-episode patients (Edwards, Pattison, Jackson, & Wales, 2001). Difficulties in emotion recognition have been found to be associated with poorer social functioning in outpatients with schizophrenia (Couture, Penn, & Roberts, 2006; Hooker & Park, 2002; Mueser et al 1996; Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). Corollary to this association with social functioning, Sergi and colleagues (2006) recently found that social cognitive functioning mediated the relationship between basic neurocognitive functioning and social functioning in schizophrenia patients. Such mediation would indicate that social cognitive processes, with emotion recognition being one component of social cognition, are uniquely involved in proficient social functioning.

While there is consensus regarding the presence of deficits in emotion recognition in schizophrenia, the specificity of this deficit and the differential emotion profile of deficits have yet to be fully understood (Edwards, Jackson, & Pattison, 2002; Kerr & Neale, 1993; Johnston, Katsikitis, & Carr, 2001, Borod, Martin, Alpert, Brozgold, & Welkowitz, 1993; Mandal, Panday, & Prasad, 1998; Phillips et al, 1999). Kerr and Neale (1993) have argued that the deficits in emotion recognition, as assessed with facial and prosodic emotion recognition tasks, are due to a general performance deficit. Patients and controls performed facial and prosodic emotion perception tasks as well as a control facial identification task and a speech-sound perception task, all of which had been standardized and cross-validated prior to the group comparisons. Patients performed worse on both the emotion perception tasks and the control tasks compared to healthy controls. Furthermore, patients differed from controls equally across both the emotion and the control tasks leading the authors to suggest that both types of tasks (e.g. the emotion perception task and facial identification task) were assessing the same construct.

However, other groups have found differential performance on prosodic emotion recognition tasks (Hooker & Park, 2002; Murphy & Cutting, 1990). Hooker and Park (2002) found that patients, compared to controls, performed worse on a vocal affect recognition task but similarly to controls on a pitch perception task. While not completely fulfilling the requirements for assessing a differential deficit (Chapman and Chapman, 1978) the authors argued that difficulties seen in patients on the vocal affect recognition task were not due to basic auditory perception deficits. Taken together, these studies indicate that differential deficits in emotion recognition may differ across modality. Although, the difficulty in strictly adhering to the suggestions by Chapman and Chapman (1978) circumscribes any conclusions made.

The relative specificity in emotion recognition deficits identified in schizophrenia is continually a matter of debate (Johnston et al 2001; Phillips et al; 1999; Kohler et al, 2003). Some argue for a specific negative emotion deficit (Kohler et al, 2003) as being the result of dysregulated neural pathways underlying the accurate detection of negatively valenced emotions, whereas others believe that the differential deficits seen are the result of methodological design flaws. Johnston and colleagues (2003; 2006) argue that the differential emotion recognition deficits found in some studies could be accounted for by inadequate matching of item difficulty for the emotional stimuli that are used in tasks. Specifically, the authors make the point that the within group overlap of structural features in negative emotions may make the discrimination of negative emotions more difficult. This within group similarity of structural features can lead to unequal variations in item difficulty when comparing the traditionally used positively valenced emotion (e.g. happy) with the traditionally used negatively valenced emotions (e.g. anger, sadness, fear and disgust). Recently, Johnston and colleagues (2003), found support for this argument when they presented degraded facial stimuli to controls in order to equate performance on the emotion recognition task to that of patients with schizophrenia. When their performance was separated by emotion, the degraded stimuli controls were equally as impaired on sad and fearful faces as the patients were. The authors suggest that this similarity in the pattern of performance between degraded stimuli controls and patients argues against a differential negative emotion deficit. Rather, when the task is sufficiently difficult as to create variability in the performance of controls, both patients and controls exhibit the same performance pattern.

Recent meta-analyses and reviews of the emotion recognition literature in schizophrenia indicate that still faces are overwhelmingly chosen as the stimulus for tasks (Kohler et al, 2010; Edwards et al, 2002). In recent years, emotional prosody stimuli have been incorporated into emotion recognition batteries with increasing frequency (Hoekert, Kahn, Pijnenborg, & Aleman, 2007; Edwards et al, 2002). The inclusion of non-traditional stimuli (e.g. emotional prosody) can lead to a more holistic understanding of the nature of emotion recognition deficits in schizophrenia. Facial emotion expression and emotional prosody are important indicators of an individual's internal state, but they are not exhaustive. An individual's gait or body movements provide rich information in the way of social communication (Dittrich, Troscianko, Lea, & Morgan, 1998; Barclay, Cutting, & Kozlowski, 1978; Ikeda & Watanabe, 2009). Traditionally, the study of gait perception has utilized point light displays (PLD; Blake & Shiffrar, 2007). Such seemingly sparse stimulus presentation can provide a robust presentation of a wide range of socially relevant information. Chouchourelou and colleagues (2006) demonstrated that the presence of emotion in gait enhanced the perception of biological motion in noise. Beyond the overall enhancement of biological motion detection, the authors found that the presence of anger in the movement had a uniquely facilitative effect on the detection of biological motion. Ikeda and Watanabe (2009) produced similar results when investigating the facilitative role of emotion in PLD on a basic biological motion discrimination task. Participants exhibited greater discriminatory ability when the biological motion contained emotional content than when it did not. Thus, the presence of emotional components in human movement seems to aid in its detection and provide salient cues for subsequent social behavior.

To our knowledge, far less attention has been paid to the recognition of emotion in gait in the schizophrenia literature. Couture and colleagues (2010) recently conducted a study investigating social cognitive processes in both individuals with schizophrenia and high functioning individuals with autism (HFA). Patients with schizophrenia and the HFA group performed significantly worse in the perception of emotion presented with point light displays. Citing poor statistical power, schizophrenia patients did not exhibit differential performance across emotional valence. Post-hoc comparison of effect sizes indicated that patients performed worse on the recognition of happy from the point light displays compared to controls. Thus there is some debate as to nature of emotion recognition deficits from gait in schizophrenia.

The goal of the current study was to investigate whether individuals with schizophrenia exhibit a deficit in the recognition of emotion in gait. Moreover, in order to assess whether this is a differential deficit, a gender recognition task was included as a social cognitive control task. The ability to accurately identify the gender of another individual is also an important aspect of successful social interactions. Parametrically adjusted intensity levels of the emotion and gender were incorporated in order to identify whether there is a point at which patients would perform similarly to controls. For the current study, the emotions used were happy and angry in order to match the emotions on approach but not on valence (Davidson, 1998). This decision was intended to control for any directional cue that could confound the results. The speed with which the stimuli moved was also equated across both happy and angry gait in order to isolate the influence of coordinated postural cues on emotion recognition. In accordance with Couture and colleagues (2010), we predicted that patients would perform worse at correctly identifying the emotion present in the stimulus. Furthermore, patients would perform significantly worse at identifying anger compared to happy which would be consistent with previous findings (Mandal et al 1998; Phillips et al, 1999). We do not have a particular prediction for gender recognition performance in the patient group. Due to the mixed findings in a recent meta-analysis on facial emotion recognition performance and clinical symptoms, we do not have any specific predictions on whether recognition of emotion in gait will be associated with patients' current symptomatology.

CHAPTER II

METHODS

Participants

Twenty-two schizophrenia outpatients were recruited from a local outpatient clinic. Diagnoses were made according to the Diagnostics and Statistical Manual of Mental Disorders, Fourth Edition Text Revised (DSM-IV-TR) using structured clinical interviews (SCID; First, Spitzer, Gibbon, & Williams, 2002). Nineteen patients were taking atypical antipsychotics (Clozapine, Olanzapine, Risperidone, Quetiapine, Haloperidol, Aripiprizole), two were taking typical antipsychotics (Thiothixene), and one was taking venlafaxine. CPZ equivalent dose was 332.59 mg. Clinical symptoms were assessed using the Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962), the Schedule for Assessing Positive Symptoms (SAPS; Andreasen, 1984), and the Schedule for Assessing Negative Symptoms (SANS; Andreasen, 1984). Twenty healthy controls were recruited from the same community as the outpatients using advertisements and brochures. All controls were screened for current and prior history of mental disorders using structured clinical interviews. Participants were excluded if they had a prior history of head injury or neurological disorder or a history of psychosis in the family. Participants were also excluded if they had a history of drug use in the year prior to the study.

Intelligence (IQ) was tested using the American National Adult Reading Test (ANART; Blair & Spreen, 1989), an assessment tool measuring premorbid IQ. All subjects were assessed to be of at least average intelligence. Years of education were also assessed as a proxy for prior level of educational attainment. All participants had normal or corrected to normal vision. Participants gave informed consent as specified by the study's Institutional Review Board. Both groups were matched on age and gender but not IQ or years of education. Table 1 presents the demographic characteristics of the two groups.

Table 1. Demographic characteristics of the patient and control groups.

	Patients Mean (s.d.)	Controls Mean (s.d.)	t	p
Age	40.45 (8.02)	38.45 (8.57)	.78	.44
Sex	7 F / 15 M	9 F / 11 M	Chi = .77	.379
Edinburgh handedness	54.27 (58.16)	84.5 (8.57)	2.22	.035
Years of Education	13.24 (2.66)	15.70 (2.60)	2.99	.0007
IQ	99.26 (10.00)	108.42 (5.40)	3.74	.005
SAPS	15.19 (9.47)			
SANS	20.76 (14.53)			
BPRS	13.71 (7.54)			
Medication (CPZ Equivalent)	332.59 (237.56)			
PANAS-PA	33.05 (7.49)	34.56 (6.30)	.667	.509
PANAS-NA	20.33 (9.37)	16.00 (7.16)	1.59	.120
SFS-Withdrawal	101.34 (12.72)	120.82 (9.97)	5.18	.0001
SFS- Interpersonal	118.00 (29.10)	140.80 (8.69)	3.46	.0019
SFS- Independent Competence	112.55 (9.99)	114.87 (7.89)	.787	.436
SFS- Independent Performance	115.81 (8.28)	119.73 (5.39)	1.74	.091
SFS- Recreation	110.41 (25.88)	132.07 (11.79)	3.44	.0017
SFS- Prosocial	111.59 (11.89)	126.07 (10.66)	3.87	.0005
SFS- Employment	105.39 (13.53)	120.03 (4.45)	4.72	< .0001

Design

There were two tasks: affect and gender recognition. The Affect task consisted of three emotions: anger, happy and neutral. There were a total of 224 trials consisting of 32 neutral trials, 96 Happy and 96 Angry trials. Within 96 trials of Angry or Happy stimuli, there were three levels of intensity (50%, 100%, 150%). Neutral stimuli did not vary in intensity. 224 trials were presented in 8 blocks. Thus, within one block there were 4 neutral trials, 12 Happy (4x each intensity level) and 12 (4x each intensity level) Angry trials. Presentation of different intensities and emotions was randomized within each block.

The Gender task consisted of female, male and neutral. There were a total of 224 trials consisting of 32 neutral trials, 96 female and 96 male trials. Within 96 trials of female or male trials, there were three levels of intensity (50%, 100%, 150%). 224 trials were presented in 8 blocks. Thus, within one block there were 4 neutral trials, 12 male (4x each intensity level) and 12 (4x each intensity level) female trials. Presentation of different intensities and gender trait was randomized within each block.

For both tasks, participants sat 16.5 inches away from the screen of a Macintosh computer with a 32-inch screen. Both tasks were administered with the presentation software PsyScope (PsyScope X B57). Presentation of the two tasks was counter-balanced across participants. All participants were given detailed instructions and provided with 10 practice trials to make sure that they understood the task procedure. Participants were informed that accuracy was more important than speed and that there was not a time limit in providing a response. After each block of trials, participants were allowed to take a short break before continuing with the task.

Procedure

Affect recognition task

A more detailed description of the creation and standardization of the stimuli can be found elsewhere (Giese & Lappe, 2002, Roether, Omlor, Christensen, & Giese, 2009). The stimuli were volumetric polygonal figures walking towards the viewer angled to the participant's left side, in order to provide full perspective of gait. The dimensions for the stimuli were 672 x 504 pixels. For an example of the stimuli used, see Figure 1.

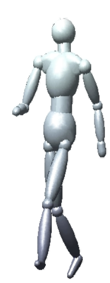

Figure 1. Experimental stimuli for the affect recognition and gender recognition tasks

There were three categories of stimuli for the affect recognition task: Happy, Angry, and Neutral. In the Happy and Angry categories, there were three levels of intensity: 50%, 100%, and 150%. These intensities reflected the amount of affective signal within the stimuli. Roether and colleagues (2009), investigated the critical components required to recognize different affects in gait and then produced stimuli that was systematically adjusted to produce various intensities of a particular affect in a stimuli's gait. The Neutral stimulus was devoid of an affective component to its gait.

At the beginning of the task participants were told that they would be viewing walking mannequins and would then be asked to make a decision on whether the mannequin's gait seemed happy or angry. Participants were asked to place their left and right index fingers on two keys labeled with H (for happy) and A (for angry), respectively. Each stimulus was presented for one second. After viewing the stimulus, participants were asked to press H or A.

An example of a single trial is presented in Figure 2.

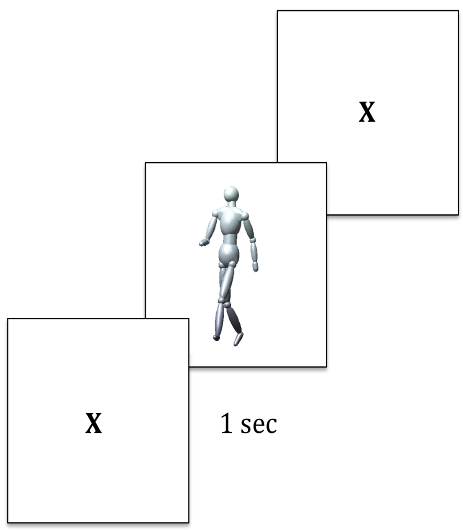

Figure 2. Example of the affect recognition and gender recognition task progression

There were 224 trials, separated into 8 blocks. When determining a participant's accuracy on the affect task, responses to the Neutral stimulus (32 trials) were not included in the analyses. The Neutral stimulus responses were analyzed in order to investigate whether there were systematic differences between each groups' responses regarding the labeling of the neutral walker with an emotion.

Gender recognition task

As with the affect recognition task stimuli, a more detailed explanation on the creation of the gender recognition task stimuli can be found elsewhere (Giese & Lappe, 2002). The procedures for the gender recognition task are identical to the affect recognition task. There were three categories of stimuli: Female, Male, and Neutral. For the Female and Male categories there were three levels of intensities: 50%, 100%, and 150%.

Participants were instructed they would be viewing mannequins walking and that they would make a decision on whether the mannequin's gait was like that of a female or a male. Responses for this task were made by pressing the keys labeled 'F' or 'M' with their left or right index fingers to indicate if they thought the mannequin's gait was female or male, respectively. Each stimulus was presented for one second. After viewing the stimulus, participants were asked to press F or M.

There were 224 trials separated into 8 blocks with the stimuli repeated 4 times, in randomized order. Responses to the Neutral stimulus (32 trials) were not included in the accuracy analyses, as there is no 'correct' answer but we examined the neutral trials to determine the baseline bias for perceiving gender in the gait.

Personality and social measures

Immediately after completion of the two behavioral tasks, participants were given the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS is a well-validated self-report measure of general mood during the preceding month.

The Social Functioning Scale (SFS; Birchwood, Smith, Cochrane, Wetton, & Copestake, 1990) was used to evaluate recent social functioning. The SFS is an interview-based assessment of social functioning over the past three months. It is comprised of seven subscales: Social Engagement/Withdrawal, Interpersonal Communication, Independence-Performance, Independence-Competence, Recreation, Prosocial, and Employment/Occupation. Scores are reported in their standardized form.

Data Analysis

To calculate participants' biases on the Affect and Gender Recognition task, the formula for bias in a forced choice paradigm was used as indicated by signal detection theory (SDT; Green & Swets, 1966). The absolute value of each participant's bias score was used to assess between group bias magnitudes. Group differences in bias magnitude were assessed with independent t-tests. Bias was also coded for categorical direction (e.g. bias towards Happy responses) and between group differences were assessed with chi-squared analyses.

Accuracy on each task was computed by dividing the total number of correct by the total number of trials. Neutral trials do not have "correct" responses and were excluded from accuracy analysis.

For neutral trials, we computed the number of Happy and Angry responses. A chi square analysis was performed to investigate group differences in response tendency. The same analyses were performed for the neutral trials in the gender recognition task.

Spearman's correlations were performed in order to assess associations between performance on the tasks, social functioning, personality measures, and current symptom status.

CHAPTER III

RESULTS

A repeated measures multifactorial ANOVA with diagnosis as the between-group factor and affect or trait, and intensity of stimulus as within-group factors was conducted. Spearman correlations and chi-square tests were also used. All tests were 2-tailed unless otherwise indicated.

Bias

Results are displayed in Figures 3. The magnitude of bias on the Affect Recognition Task did not differ between the two groups (t(40) = 1.03, p=.302). On the Gender Recognition Task, the magnitude of bias did not differ between groups (t(40) = -1.08, p= .278). For both recognition tasks, there was no group difference in categorical direction of bias on the Affect task ($X^2(1) = 2.93$, p= .087) or the Gender task ($X^2(1) = .042$, p= .837).

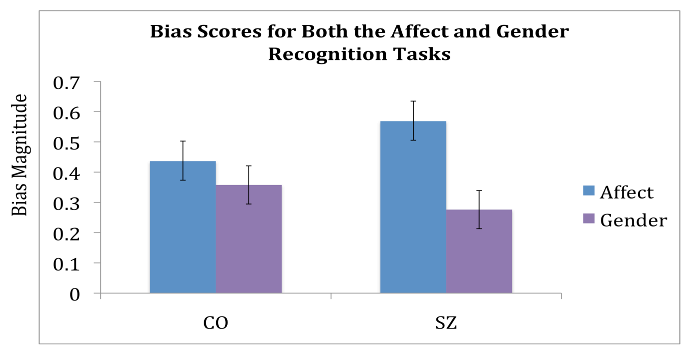

Figure 3. Bias scores for both patients and controls on the affect recognition and gender recognition tasks

Affect Recognition Task

Results are displayed in Figures 4 and 5. There was a significant main effect of diagnostic group (F(1,40) = 11.17, p = .0018). Patients were significantly less accurate than controls on the Affect Recognition Task. There was also a significant main effect of Affect (F(1,40) = 13.72, p = .0006). Overall, participants were more accurate at identifying Happiness in gait than Anger. There was a significant main effect of Intensity (F(1,40) = 122.45, p < .0001). Across both groups, accuracy in affect recognition increased as the intensity of the signal increased.

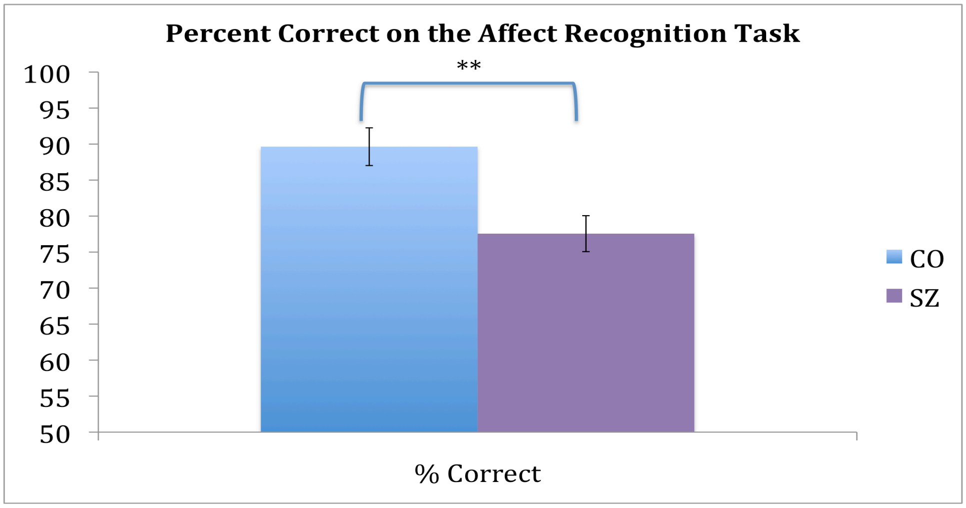

Figure 4. Percent correct on the affect recognition task for patients and controls. ** p<.005.

Interestingly, there was an Affect-by-Intensity interaction (F(2,40) = 56.32, p <.0001). Across both groups, performance at the 50% (t(41) = 6.18, p <.0001) and the 100% (t(41) = 2.23, p = .032) was significantly better for the Happy condition than the Angry condition. Performance at the 150% was not significantly different between conditions (t(41) = .636, p = .528).

Planned contrasts revealed that patients performed significantly worse on the Angry condition compared to the Happy condition. (t(21) = 2.43, p = .024). When performance on the Anger and Happy conditions is separated by Intensity level, patients performed significantly worse at the 50% (t(21) = 4.01, p = .0006), but not at the 100% (t(21) = 1.62, p= .120), and the 150% (t(21) = .337, p = .739). Patients exhibited poorer performance in recognizing Anger in gait compared to Happy in gait when the affective signals were attenuated.

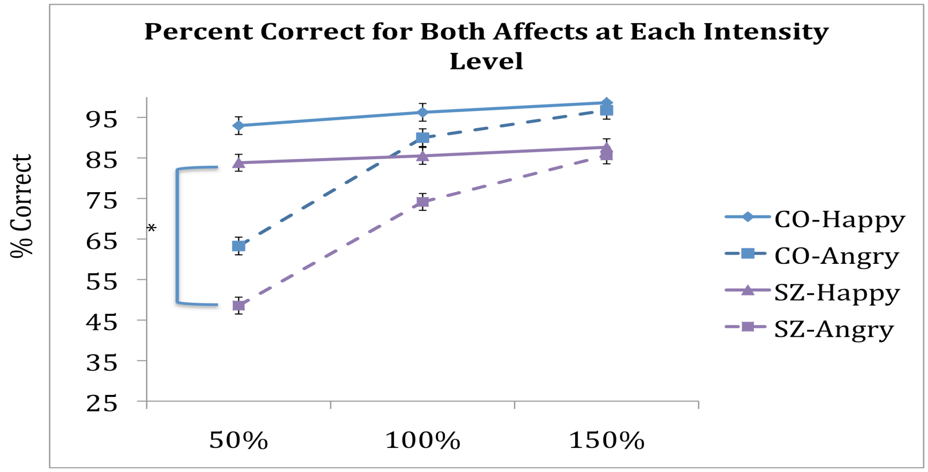

Figure 5. Percent correct for each affect at each intensity level on the affect recognition task for patients and controls

Gender recognition task

Results are displayed in Figures 6 and 7. There was no main effect of diagnostic group (F(1,40) = 3.749, p = .060); patients and controls performed similarly in recognition of gender from gait. There was no main effect of gender type (F(1,40) = 3.77, p = .059), across both groups, there was no difference in the recognition of female or male gait. There was a significant main effect of Intensity whereby performance improved as the gender signal increased for both groups (F(2,40) = 130.64, p < .0001).

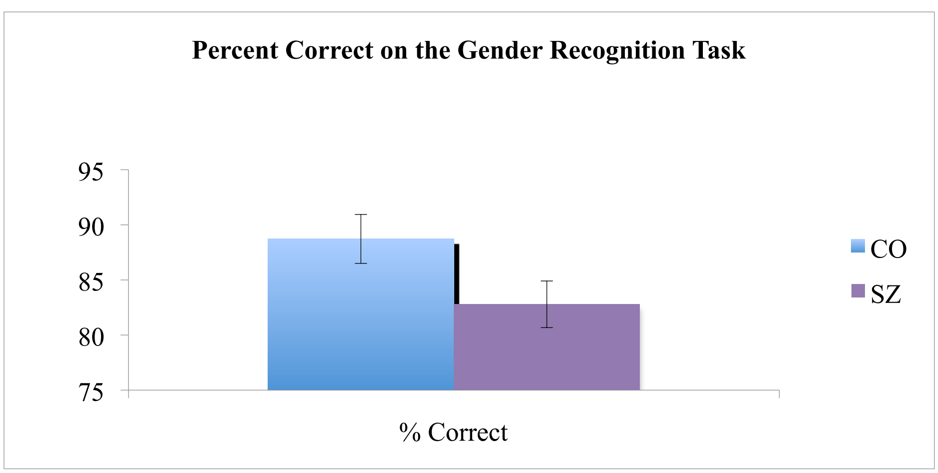

Figure 6. Percent correct on the gender recognition task for patients and controls

There was a Gender-by-Intensity interaction (F(2,40) = 18.53, p < .0001) whereby across both groups, recognition of Male gait was significantly better than recognition of Female gait for 50% signal intensity (t(41) = 3.45, p = .0013). Performance did not significantly differ for the 100% (t(41) = 1.45, p = .153) or the 150% t(41) = 1.77, p = .085) intensity conditions.

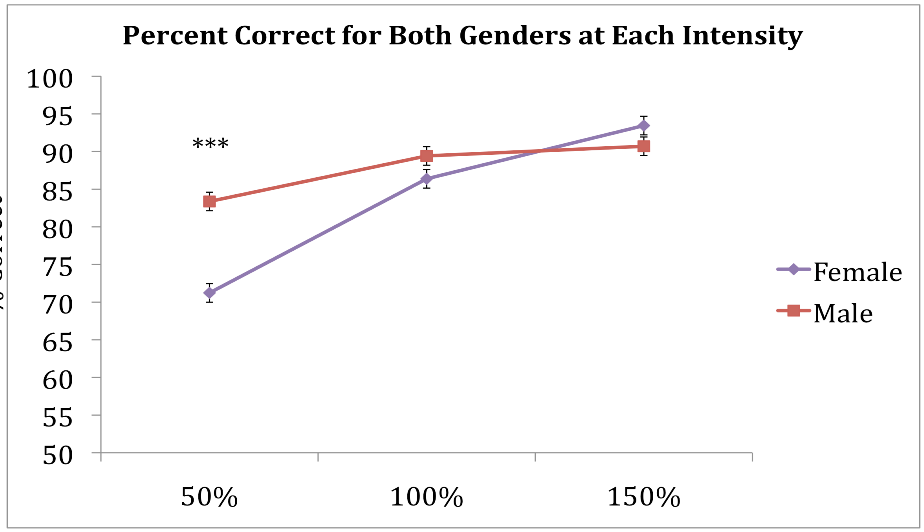

Figure 7. Percent correct for each gender at each intensity level on the gender recognition task for patients and controls. ***p<.001

Direct comparison of the affect recognition and gender recognition tasks

Results are presented in Figure 8. There was no main effect of task (F(1,40) = .502, p = .483) across both groups, performance did not differ between the affect recognition task and the gender recognition task. Furthermore, there was not a Group x Task interaction (F(1,40) = .439, p = .511). Neither group exhibited greater differential performance on the two tasks.

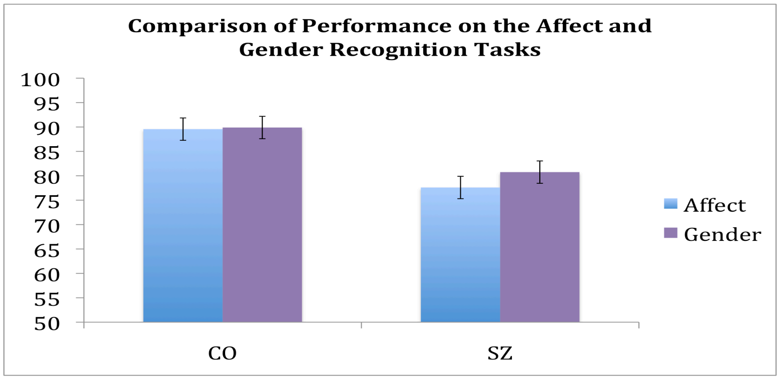

Figure 8. Percent correct on both the affect recognition and gender recognition tasks for patients and controls.

Neutral Stimulus Responses for the Affect Recognition Task

Results are presented in Table 2. A chi square analysis indicates that overall, participants were more likely to identify a majority of the neutral stimuli as happy ($X^2(1) = 5.352$, p = .021). Eighteen percent of the participants in the patient group indicated a majority of their responses to the neutral stimulus as angry compared to the control group in which none of the participants showed this response pattern.

Table 2. Coded Identification of the neutral stimulus by group.

	Happy # (%)	Angry # (%)	Female # (%)	Male # (%)
Patients	18 (81.82%)	4 (18.16%)	4 (18.18%)	18 (81.82%)
Controls	19 (100%)	0 (0%)	5 (26.32%)	14 (73.68%)
Overall	37 (90.24%)*	4 (9.76%)*	9 (21.95%)	32 (78.05%)

Note. * p= .021

Neutral stimulus responses to Gender task

Results are presented in Table 2. A chi square analysis indicates that overall, participants were equal in their identification of the neutral stimulus as female or male ($X^2(1)= .393$, p = .531). Twenty-two percent of participants indicated a majority of their responses to the neutral stimulus as female compared to 78% of participants who indicated a majority of their responses to the neutral stimulus as male.

Correlations

Results are presented in Figure 9. Performance on either task was not associated with current symptom status or demographic factors. On the Affect Recognition Task, patients' identification of the neutral stimulus as Happy was positively associated with self-reported positive affect as measured by the PANAS ($r_s = .57$, $p = .007$).

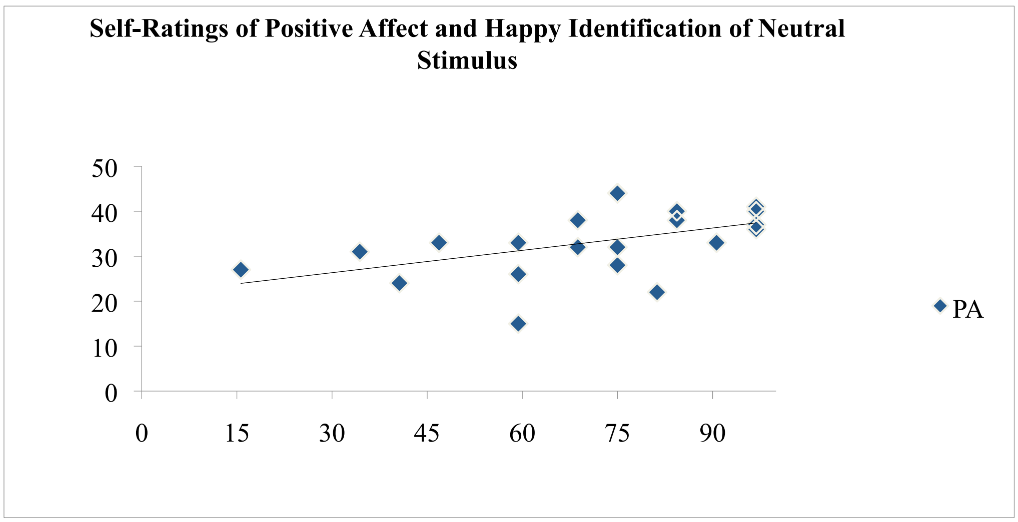

Figure 9. Association between self-reported positive affect and percent of neutral stimuli identified as happy on the affect recognition task in patients

CHAPTER IV

DISCUSSION

In this study we examined emotion recognition from gait in patients with schizophrenia and controls. Emotion recognition was assessed using polygonal walkers expressing either happiness or anger in their movement. Gender recognition was assessed using polygonal walkers whose gait was feminine or masculine in order to have a social information control task. Consistent with our predictions, patients were significantly impaired in their recognition of emotion in gait. Furthermore, this impairment was significantly greater for the recognition of anger compared to happiness.

While the impaired emotion recognition performance is in line with the findings of Couture and colleagues (2010) we did not replicate their report of greater impairment in positive emotion recognition. This contradictory finding could be due to the difference in task presentation and format. In the current study, the stimuli used were matched for speed of gait in order to control for velocity cues that might confound the recognition of emotions. Previous research (Pollick, Paterson, Bruderlin, & Sanford, 2001) has indicated that the velocity of an expressive emotional movement can have a large effect on the identification of the emotion, which could account for the findings of the current study. By controlling for the speed of the walkers in both the happy and angry condition, participants had to rely on accurate identification of the coordinated postural cues that indicate a particular emotion. Couture and colleagues did not report that speed of movement was controlled in their study, which may have lead to the improved recognition of the negative emotions. Finally, their gait stimuli ranged in presentation times of 5 seconds to 20 seconds whereas in the current study all stimuli played for 1 second. This variation of presentation time may have differentially affected recognition performance in participants.

The greater difficulty in the recognition of anger is consistent with previous findings (Kohler et al 2003; Phillips et al 1999). Interestingly though, the results indicated that both patients and controls were significantly worse at the overall recognition of anger compared to happiness in gait. Such a pattern of performance would argue against a differential negative emotion deficit in patients with schizophrenia (Johnston, Devir, & Karayanidis, 2006). When performance was analyzed by intensity level, it seemed that the low accuracy of the attenuated angry gait (e.g. 50%) was driving the effect. Within group performance for the 100% angry and happy stimuli is not significantly different. Therefore, once the emotional signal is at the level at which people were recorded moving, participants are recognizing both emotions with equal accuracy. A possible explanation for this is that equating the stimuli for speed of movement increased the difficulty in discriminating happy movement from angry movement. As noted earlier, previous research (Chouchourelou, Matsuka, Harber, & Shiffrar, 2006; Ikeda & Watanabe, 2009) suggests that anger in gait has a facilitative effect in the perception of biological motion. Future studies should consider the role of speed of gait in assessing emotion recognition from gait in schizophrenia. Our intent was to control for possible confounds outside of the coordinated postural indicators, which might have resulted in this overall differential emotion recognition performance.

While not predicted, the patients did not perform significantly worse on the gender recognition task compared to controls. Therefore, there seems to be evidence that the difficulty in extracting socially relevant information is not fully impaired in individuals with schizophrenia. Corollary to this is the pattern of performance wherein as the intensity of the affective or gender signal increased performance in both groups increased. While overall performance on the affect recognition task was impaired in patients, their performance improved in the angry condition as the intensity increased, similar to the performance seen in the controls. These findings are partially consistent with what Kohler and colleagues (2003) found in their study on the effect of the intensity of facial expression on performance. Similar to the current study, performance was improved for the high intensity facial expression recognition task but patients were still significantly impaired compared to controls. These findings would suggest that patients are able to detect the presence of emotion in expressions but that they are less efficient. Patient's recognition of gender appears to be intact which supports the notion that the perception and recognition of social information is not fully compromised.

The lack of difference in performance on the gender recognition task between patients and controls may be due to recognition of gender requiring less depth of processing compared to recognizing another individual's emotional state. The simulation theory posits that we recognize the emotional states of others by internally modeling the observed behaviors of the other person (Hurley & Charter, 2005). Recognition of gender may not require this internal simulation process; rather it may rely on more explicit external cues. Previous research indicates that individuals with schizophrenia exhibit deficits in the ability to imitate the gestures and facial expressions of others (Park, Matthews, & Gibson, 2008). Therefore, this difficulty with imitative behavior may be related to an impaired internal simulation process for the subsequent recognition of emotion in others.

The positive association found in patients between their identification of the neutral gait walker as happy and their self-reported positive affect was an unexpected finding. Both groups were biased towards responding that the neutral gait walker was happy but this association between self-report affect was only found in patients. The lack of a similar correlation in controls suggests perhaps that patients use their own internal state as a greater indicator of external perceptions. In a recent review by Kring and Moran (2008) the authors reported that research on the emotional experience of patients indicates that individuals with schizophrenia report comparable internal experiences of emotion to that of what healthy individuals report experiencing. Therefore, this preserved internal state experience may guide a patient's perception of the emotional world around them. Participants were not told that there was a neutral gait walker included in the task, thus their response to the stimulus is somewhat projective in nature. Further investigation into the role of the patient's internal state and their perception of the social world is indicated.

Unfortunately, neither the ratings of patients' current symptoms nor their current social functioning were associated with performance on either task. This lack of association could be a result of the population recruited for participation. The patient group was composed of relatively high functioning outpatients who were medicated at the time of testing; such a group may not be fully representative. A recent review by Kohler and colleagues (2010) indicates a fair amount of heterogeneity in the associations between emotion recognition and clinical symptoms. Furthermore, the relatively small sample size of the patient group may have reduced the power needed to detect associations between clinical symptoms and performance. Couture and colleagues did not report on whether there were associations between patients' performance and clinical symptoms, indicating that further research is needed in order to elucidate the potential relationship between clinical symptoms and the recognition of emotion in gait.

In conclusion, patients exhibit a deficit in extracting emotional information from human movement. This deficit does not seem to extend to more basic social judgments as indicated by similar performance on the gender recognition task compared to controls. Interestingly, patients and controls exhibited similar facilitation of performance as the intensity of the "social signal" increased in the stimulus on both tasks. This suggests that patients are able to take advantage of the increasing signal to guide their behavior. Future studies should investigate this facilitative aspect of signal intensity to determine whether patients could be trained to detect weaker signals by using exaggerated cues initially. If, through training, the patient's sensitivity to the signal could be increased, this could lead to improvement in emotion recognition. The current study only investigated the recognition performance of two emotions; further studies should expand the emotional repertoire in order to characterize patient performance with regards to gait presented emotion.

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