Social and Emotional Experiences in Schizophrenia

BY

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THESIS

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I would like to dedicate this thesis to my husband, Deep, whose patience and support has meant the world to me.
ACKNOWLEDGEMENTS

I would like to thank my thesis committee—Ellen Herbener, Jon Kassel, and Stew Shankman—for all their assistance and support throughout the formulation and development of this project. Their feedback was an invaluable asset to me, and without it, the quality of my work would have suffered. I would also like to acknowledge Autym Henderson, whose guidance was essential in navigating the administrative aspects of the process.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>DSM-IV</td>
<td>Diagnostic and Statistical Manual of Mental Disorders, 4th Edition</td>
</tr>
<tr>
<td>HC</td>
<td>Healthy Participants</td>
</tr>
<tr>
<td>HDRS</td>
<td>Hamilton Depression Rating Scale</td>
</tr>
<tr>
<td>PANSS</td>
<td>Positive and Negative Syndrome Scale</td>
</tr>
<tr>
<td>SHNS</td>
<td>Schizophrenia High Negative Symptoms Group</td>
</tr>
<tr>
<td>SLNS</td>
<td>Schizophrenia Low Negative Symptoms Group</td>
</tr>
<tr>
<td>SZ</td>
<td>Schizophrenia Participants</td>
</tr>
<tr>
<td>WASI</td>
<td>Wechsler Abbreviated Scale of Intelligence</td>
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<tr>
<td>WRAT</td>
<td>Wide Range Achievement Test</td>
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SUMMARY

The present study examined factors relating to momentary emotional response (i.e., arousal and valence ratings of affective stimuli) in 38 individuals with schizophrenia (SZ) and 53 healthy individuals (HC). Participants completed an affective picture stimuli ratings task to assess in-the-moment positive, negative, and neutral emotional experiences, and the factors examined were social (human) content and symptom presentation.

The results indicated that slides with social content were rated as more arousing and more negative than slides without social content, by all participants, but that SZ rated slides as more arousing than HC. Further, within negative stimuli, HC were more aroused by social than nonsocial slides, whereas SZ displayed the opposite pattern. Also within negative stimuli, SZ with high negative symptoms (SHNS) rated social stimuli as less arousing than SZ with low negative symptoms (SLNS), but SHNS and SLNS did not differ in their arousal ratings of nonsocial stimuli.

These findings exhibit a heightened level of arousal in schizophrenia, which is dampened by negative symptom severity, but only for negative slides with social content. This suggests that social content and symptom presentation may indeed play a role in momentary emotional experiences in schizophrenia.
I. INTRODUCTION

In the last two decades, a significant research literature has emerged reporting on what has been found to be a paradox in emotional functioning in schizophrenia. This paradox lies in the fact that although individuals with schizophrenia tend to describe positive emotional stimuli less positively in tasks assessing anticipation or memory for stimuli (Gard, Kring, Germans Gard, Horan, & Green, 2007; Herbener, Rosen, Khine, & Sweeney, 2007; Horan, Green, Kring, & Nuechterlein, 2006; Pizzagalli, 2010), they often self-report “normal” responses to emotional stimuli while experiencing them in the moment (Gard et al., 2007; Hempel et al., 2005; Herbener, Song, Khine, & Sweeney, 2008; Horan et al., 2006).

However, some studies of momentary reports of affective responses to emotional stimuli have documented differences between schizophrenia and healthy control groups (Burbridge & Barch, 2007; Dowd & Barch, 2010). Specifically, Dowd & Barch (2010) found that schizophrenia patients reported blunted in-the-moment experiences, (i.e., they reported experiencing positive stimuli less positively than healthy subjects and negative stimuli less negatively than healthy subjects). Burbridge & Barch (2007) found that their schizophrenia subjects were less aroused by negative stimuli when compared to controls, but reported similar arousal and valence ratings in response to positive and neutral stimuli. However, Lee et al. (2006) found that schizophrenia subjects rated positive picture stimuli less positively, but their responses to negative stimuli varied depending on the level of arousal of the stimuli. At this point, it remains unclear how to explain differences in emotional experience in schizophrenia across studies. Given the heterogeneity in schizophrenia samples, inconsistent results across studies may be partly due to the fact that none of the studies to date have examined emotional experience as a function of symptom presentation.
A. **Role of Symptoms in Emotional Response**

Differences in emotional response to stimuli may be related to symptoms. Specifically, past research indicates that one way in which emotional experience varies within schizophrenia is that some individuals report less intense positive and negative emotions (Carpenter, Heinrichs, & Wagman, 1988; Kirkpatrick, Buchanan, Ross, & Carpenter, 2001; Strauss, Harrow, Grossman, & Rosen, 2010). This decreased emotional experience marks the reduction of key aspects of human experience such as motivation, social behavior, speech, and the experience of enjoyment, and is typically associated with high levels of negative symptoms (Arango, Buchanan, Kirkpatrick, & Carpenter, 2004; Heinrichs, Hanlon, & Carpenter, 1984). Individuals with schizophrenia with prominent and persistent negative symptoms also tend to experience less severe mood symptoms (Cohen, Brown, & Minor, 2010; Kirkpatrick, Buchanan, Breier, & Carpenter, 1994).

Differences in positive symptom severity have also been associated with response to affective stimuli. Lee and colleagues (2006) not only found differences between schizophrenia patients and healthy controls in their emotional response to affective stimuli, but also noted different patterns of responsivity between schizophrenic individuals with and without prominent positive symptoms. In particular, they found that within the schizophrenia patients, the non-paranoid subgroup responded more negatively and less positively, and the paranoid subgroup responded more to lowly arousing stimuli and less to highly arousing stimuli (Lee et al., 2006). Further, Russell and colleagues (2007) found different patterns in neural activation between paranoid and non-paranoid individuals with schizophrenia in response to emotional facial expressions.
Depressive symptoms also contribute to the heterogeneity in schizophrenia samples, as about one-third of these individuals experience full depressive syndromes during the course of the illness (Sands & Harrow, 1999). Further, some subgroups appear to be vulnerable to recurrent depressive symptoms, whereas others are more resistant (Sands & Harrow, 1999). Depression has been associated with a negative attentional bias, in which depressed individuals tend to attend to sad faces whereas healthy controls avoid sad faces and orient toward happy faces whenever possible (Joormann & Gotlib, 2007). This higher responsivity to negative relative to positive stimuli found in depressed individuals may also be present in schizophrenic individuals with depressive symptoms.

B. **Role of Content in Emotional Response**

Another potential explanation for inconsistencies in the research on emotional experience is that researchers have not considered how stimulus content might influence responses. Particularly, individuals with schizophrenia have been shown to have difficulties in accurate facial affect and social cue perception (Bigelow et al., 2006; Hooker & Park, 2002; Turetsky et al., 2007); this difficulty could reasonably influence their emotional responses to social and nonsocial stimuli. Multiple studies have demonstrated that schizophrenia patients exhibit a deficit in recognition of emotion indicated by facial or vocal expression (Bigelow et al., 2006; Johnston et al., 2010; Strauss, Jetha, Ross, Duke, & Allen, 2010; Turetsky et al., 2007), and that individuals with prominent negative symptom presentation tended to demonstrate worse performance on these tasks than other schizophrenia patients (Strauss et al., 2010). In addition, Bigelow and colleagues (2006) reported that their schizophrenia subjects exhibited impaired abilities in emotion identification for some of the socially relevant but not nonsocial stimuli, suggesting a specific deficit in social perception and cognition which may contribute to
inconsistencies in research results which combine social and nonsocial stimuli. Johnston and colleagues (2010) found that greater negative symptoms are associated with worse affect discrimination in static facial images (pictures), but greater positive symptoms are associated with worse affect discrimination in dynamic facial images (short video clips). It is not clear whether the deficit in identification of emotion from facial expressions contributes to abnormalities in emotional responses to images that include both facial expressions and contextual information.

Further, Penn, Sanna, & Roberts (2008) noted that, in addition to deficits in emotion identification, there are impairments in social cognition. In particular, schizophrenia patients have exhibited deficits in their ability to make inferences about others’ intentions (also referred to as theory of mind). This impairment in perspective-taking could contribute to reduced empathy, which in turn could contribute to differences in emotional responses to social stimuli (Derntl et al., 2009; Smith et al., 2012).

C. **Present Study Aims**

The main aim of the study is to investigate whether schizophrenic individuals with different degrees of symptom presentation have different in-the-moment ratings of emotional responses (valence and arousal) to stimuli, based on social content. All schizophrenia subjects are expected to report blunted emotional responses to social stimuli when compared to the healthy controls, providing further support for Bigelow et al (2006)’s findings that suggested a specific deficit in social perception and cognition. Blunted emotional responses will be indicated by reduced arousal and valence ratings (i.e., reporting lower levels of arousal and responding less positively to positive stimuli and less negatively to negative stimuli).
As greater negative symptom severity in schizophrenia has been related to decreased affective experience (Cohen, Brown, & Minor, 2010; Kirkpatrick, Buchanan, Breier, & Carpenter, 1994) and poor affect recognition (Strauss et al., 2010), schizophrenia subgroups based on a median split of negative symptoms are expected to differ in their emotional response to social stimuli, such that individuals with more severe negative symptoms will exhibit blunted arousal and valence responses to stimuli, compared to low-level negative symptoms groups and healthy controls. However, as both positive and depressive symptoms have also been associated with atypical emotional response, we will also investigate the extent to which these symptom subgroups differ from one another and healthy controls in their momentary response to social stimuli.

Given that Bigelow and colleagues (2006) found selective impairments in appraisals of socially relevant but not nonsocial stimuli, the present study has hypothesized that schizophrenic and control participants will not differ in their responses (valence and arousal ratings) to nonsocial visual stimuli, i.e., pictures without human content.
II. METHOD

A. Participants

Participants in this study were 38 individuals who met DSM-IV (Diagnostic and Statistical Manuals of Mental Disorders 4th ed.; American Psychiatric Association, 1994) criteria for schizophrenia or schizoaffective disorder, who were recruited from the University of Illinois at Chicago Medical Center. Fifty-three age and gender-matched healthy subjects were recruited through advertisements posted on Chicago’s public transportation system (for demographics information, see Table I). Diagnoses were determined by doctoral-level researchers using the Structural Clinical Interview for DSM-IV diagnoses (First, Spitzer, Gibbon, & Williams, 1997).

B. Instruments

The Positive and Negative Syndrome Scale (PANSS; Kay, Fiszbein, & Opler, 1987) was used to measure symptom type and severity. The PANSS is a 30-item measure rated by a clinician from a clinical interview, and includes assessment of positive and negative symptoms. For the purposes of this study, more emphasis will be placed on the negative symptoms, as the hypotheses focus on the prominent role of this aspect of schizophrenia in relation to social functioning. The negative symptom subscale includes ratings of stereotyped thinking, lack of spontaneity, blunted affect, social and emotional withdrawal, and difficulty in abstract thinking.

The Hamilton Depression Rating Scale (HDRS; Hamilton, 1960) was used to measure depressive symptom severity. The HDRS is a 24-item measure rated by a clinician from a clinical interview, and assesses negative mood, insomnia, agitation, anxiety, and weight change. The PANSS and HDRS were only administered to the schizophrenia patients, since the healthy controls were not expected to score within the clinical range on these scales. Therefore,
<table>
<thead>
<tr>
<th></th>
<th>HC</th>
<th>SZ</th>
</tr>
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<tbody>
<tr>
<td>Age</td>
<td>38.98 (10.41)</td>
<td>38.84 (10.34)</td>
</tr>
<tr>
<td>Gender M/F</td>
<td>24 /29</td>
<td>19 / 19</td>
</tr>
<tr>
<td>Education</td>
<td>13.58 (1.74)</td>
<td>14.31 (4.19)</td>
</tr>
<tr>
<td>WRAT</td>
<td>97.92 (11.78)</td>
<td>95.74 (15.98)</td>
</tr>
<tr>
<td>WASI</td>
<td>101.92 (15.04)</td>
<td>97.42 (24.34)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are in parentheses. WRAT = Wide Range Achievement Test, used as an estimate of premorbid intelligence. WASI = Wechsler Abbreviated Scale of Intelligence, used as a measure of current intelligence. None of these variables significantly differ between groups.
the data from these measures were used to create subgroups within the schizophrenia patient sample, which were then compared to each other as well as to healthy controls.

C. Procedure

The participants were consented into the study and then administered the instruments described above. Following these assessments, each participant viewed and rated 131 pictures drawn from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2001). Seventy-six of the stimuli were social (i.e., with human content, either individuals or groups) and fifty-five of the stimuli were nonsocial (i.e., without human content, such as pictures of scenery, animals, or food), and both categories included a wide range of positive and negative emotionally provocative stimuli. These pictures were presented individually on a desktop computer with a 19-inch flat screen monitor located 24 inches from where the participants were seated.

The participants were instructed to indicate, for each image, how the picture “makes [them] feel,” in order to elicit the participants’ momentary emotional reaction to the picture. They were prompted to rate each picture in terms of both valence (bad to good) and arousal (calm/bored to excited/agitated) using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The SAM is a 9-point Likert scale that uses cartoon facial and body expressions to indicate the intensity of pleasure versus displeasure, as well as arousal versus calmness. For the valence dimension, lower scores indicated negative valence and higher scores indicated positive valence, while for the arousal dimensions, lower scores indicated lower arousal and higher scores indicated greater arousal. Importantly, stimuli remained on the screen until subjects had completed their valence or arousal ratings, and thus ratings were not dependent on subjects’ memory for stimuli.
III. RESULTS

The hypothesis that social content and symptom presentation would account for differences between schizophrenic (SZ) and healthy control (HC) participants’ momentary emotional responses to visual stimuli was tested using a series of analyses of variance (ANOVAs).

A. Effect of social content on arousal and valence ratings

The first analysis tested whether SZ and HC participants differed in their emotional arousal response to social and nonsocial stimuli. This was tested using a 2 (Diagnosis: HC, SZ) x 2 (Social content: Social, non-social) repeated measures ANOVA with arousal ratings in response to all stimuli as the dependent variable. The results indicated statistically significant main effects of both the social content of stimuli and diagnostic group, but a non-significant social content X diagnostic group interaction. As indicated in Table II, all subjects rated social stimuli as more arousing than nonsocial stimuli, and SZ participants reported higher arousal in response to all stimuli than did HC participants.

An identical analysis was conducted using valence ratings in response to all stimuli. Results indicated a statistically significant effect of social content, such that all subjects reported less positive responses to social stimuli than nonsocial stimuli. Neither the main effect of diagnostic group, nor the interaction of diagnostic group and stimulus content reached statistical significance.

These initial analyses revealed that all participants tended to rate social content as more arousing and more negative, and that schizophrenia patients were more aroused than healthy controls by all of the stimuli. However, there did not appear to be differences between the
**TABLE II**

MEANS OF AROUSAL AND VALENCE AS A FUNCTION OF SOCIAL CONTENT

<table>
<thead>
<tr>
<th></th>
<th>Social</th>
<th></th>
<th>Nonsocial</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>HC</td>
<td>SZ-all</td>
<td>SZ-low</td>
<td></td>
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<td>Ratings of Emotional</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Response</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Arousal Responses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arousal Responses to</td>
<td>6.61</td>
<td>7.24</td>
<td>7.56</td>
<td>6.84</td>
</tr>
<tr>
<td>Negative Stimuli</td>
<td></td>
<td></td>
<td></td>
<td>6.36</td>
</tr>
<tr>
<td>Arousal Responses to</td>
<td>4.26</td>
<td>4.77</td>
<td>4.96</td>
<td>4.54</td>
</tr>
<tr>
<td>Neutral Stimuli</td>
<td></td>
<td></td>
<td></td>
<td>5.07</td>
</tr>
<tr>
<td>Arousal Responses to</td>
<td>4.42</td>
<td>4.79</td>
<td>5.24</td>
<td>4.24</td>
</tr>
<tr>
<td>Positive Stimuli</td>
<td></td>
<td></td>
<td></td>
<td>3.45</td>
</tr>
<tr>
<td>Arousal Responses</td>
<td>5.19</td>
<td>5.70</td>
<td>6.01</td>
<td>5.31</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td>4.83</td>
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<tr>
<td><strong>Valence Responses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valence Responses to</td>
<td>2.72</td>
<td>2.54</td>
<td>2.32</td>
<td>2.81</td>
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<tr>
<td>Negative Stimuli</td>
<td></td>
<td></td>
<td></td>
<td>3.06</td>
</tr>
<tr>
<td>Valence Responses to</td>
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<td>5.29</td>
<td>5.22</td>
<td>5.38</td>
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<td></td>
<td>4.51</td>
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<tr>
<td>Valence Responses to</td>
<td>6.54</td>
<td>6.69</td>
<td>6.72</td>
<td>6.64</td>
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<tr>
<td>Positive Stimuli</td>
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<td></td>
<td></td>
<td>6.66</td>
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<tr>
<td>Valence Responses</td>
<td>4.69</td>
<td>4.69</td>
<td>4.60</td>
<td>4.80</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td>4.89</td>
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*Note.* Higher scores on valence indicate positive valence and higher scores on arousal indicate greater arousal.
schizophrenic and control participants in arousal and valence responses to social vs. nonsocial stimuli.

B. Differences in arousal and valence ratings of social vs. nonsocial stimuli as a function of valence of stimuli

Valence was added to the next set of analyses to assess whether certain combinations of valence and content might best differentiate between SZ and HC participants. In the first analysis, a 2 (Diagnostic group: HC, SZ) x 2 (Social content: social, nonsocial) x 3 (Valence: negative, neutral, positive) repeated measures ANOVA was run using arousal ratings as the dependent variable. This analysis yielded a significant group by social content by valence interaction, $F(2, 88) = 3.16, p < .05$. This interaction was followed up by examining the group by social content interaction at each level of valence: negative, neutral, and positive. The cell means for these analyses are presented in Table II. This analysis indicated that arousal differences in response to valence and social content was significant for negative stimuli, but not positive or neutral stimuli.

Specifically, the 2 (Diagnostic group: HC, SZ) x 2 (Social content: social, nonsocial) repeated measures ANOVA conducted using arousal to negative stimuli as the dependent variable indicated a significant main effect of group, $F(1, 89) = 9.56, p < .01$, and a significant group by social content interaction, $F(2, 88) = 7.05, p < .01$. The main effect of social content was not significant, $F(1, 89) = .11, ns$. Follow-up analyses of the interaction indicated that while the control group was more aroused by the social than nonsocial negative stimuli, $t(52) = 2.23, p < .05$ (see Figure 1), the schizophrenic group trended toward being more aroused by the nonsocial than social negative stimuli, $t(37) = -1.77, p < .10, d = .30$. 
Figure 1. Mean levels of reported arousal by negative stimuli as a function of diagnostic group and social content. SZ-low = SZ subjects with low levels of negative symptoms. SZ-high = SZ subjects with high levels of negative symptoms.
The group (HC, SZ) x social content (social, nonsocial) x valence (negative, neutral, positive) repeated measures ANOVA was repeated using emotional valence response ratings as the dependent variable. No significant main or interaction effects were found beyond those described earlier.

C. **Differences between SZ and HC in arousal and valence ratings as a function of negative symptom severity**

In the third set of analyses, symptom type and severity were added as between subject variables in ANOVAs testing the effect of stimulus social content on emotional responses to stimuli. In order to test the hypothesis that negative symptom severity would be associated with emotional response to social stimuli, high and low negative symptoms schizophrenia subgroups were created based on a median split of negative symptom (PANSS score of 16) within the schizophrenia group. Based on this split, 17 schizophrenia subjects were in the high negative symptom group (SHNS), and 21 were in the low negative symptom group (SLNS).

1. **Response to social and nonsocial stimuli**

The hypothesis that the high and low negative symptoms groups would differ from each other and from healthy controls in their responses to social but not nonsocial stimuli was tested using a 3 (Diagnostic group: healthy controls, SLNS, SHNS) x 2 (Social content: Social, nonsocial) repeated measures ANOVA, with arousal ratings as the dependent variable. Our initial predictions were that individuals with greater symptom severity would have lower arousal ratings (i.e., SHNS < SLNS < HC). However, follow-up tests revealed that this hypothesis was only partly supported, $F(2, 90) = 4.42, p < .05$. The SHNS group was, in fact, less aroused by the stimuli than the SLNS group, $t(36) = 2.68, p < .05$ (see Figure 2), supporting the hypothesis. However, we also found that the control group was less aroused than the SLNS group, $t(72) =$ -
Figure 2. Mean levels of reported arousal by all stimuli as a function of diagnostic group and social content. SZ-low = SZ subjects with low levels of negative symptoms. SZ-high = SZ subjects with high levels of negative symptoms.
2.93, \( p < .01 \), and actually did not significantly differ from the SHNS group, \( t (31.44) = -.39, \text{ ns} \).

In sum, the SLNS group reported significantly higher arousal to the social stimuli than either the healthy or the SHNS group (HC = SHNS < SLNS).

It was also hypothesized that the SZ and HC groups would not differ on their overall response to nonsocial stimuli. This hypothesis was not supported, as group differences were found in reported arousal in response to nonsocial stimuli, \( F (2, 90) = 3.87, \ p < .05 \). The groups followed the same pattern of arousal in response to nonsocial stimuli as they did to social stimuli, with the SLNS group reporting greater arousal than the SHNS group, \( t (30.56) = 2.01, \ p < .06 \), and the healthy controls, \( t (72) = -2.69, \ p < .01 \). The SHNS and HC groups did not differ from each other, \( t (36.72) = -.83, \text{ ns} \) (see Figure 2).

The group (HC, SLNS, SHNS) x social content (social, nonsocial) repeated measures ANOVA described above was repeated using emotional valence response ratings as the dependent variable. No significant main or interaction effects were found.

2. **Positive and depressive symptoms**

Subgroups based on median splits of positive symptoms and depression scores were also created and tested using analyses identical to those described above. These did not yield any statistically significant results beyond the main effect of social content described in earlier analyses.\(^1\)

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\(^1\) No positive symptom group by content interaction effect was found for arousal: \( F(2, 88) = .64, \text{ ns} \), or valence: \( F(2, 88) = 2.55, \text{ ns} \).

\(^2\) No depressive symptom group by content interaction effect was found for arousal: \( F(2, 88) = .89, \text{ ns} \), or valence, \( F(2, 88) = .30, \text{ ns} \).
D. **Differences in arousal and valence ratings as a function of levels of valence of stimuli and negative symptom severity**

1. **Arousal ratings**

   Given that the earlier analyses revealed different patterns of emotional response to stimuli based on negative symptom severity, social content, and level of valence, a 3 (Symptom group: HC, SLNS, SHNS) x 2 (Social content: social, nonsocial) x 3 (Valence: negative, neutral, positive) ANOVA was run using arousal ratings as the dependent variable in order to test how symptom presentation, social content, and valence level of stimuli interact with one another to influence momentary emotional response. This analysis yielded a significant symptom group by social content by valence interaction, $F(2, 88) = 3.17, p < .05$. This significant three-way interaction was followed up by examining the symptom group by social content interaction at each level of valence: negative, neutral, and positive. The cell means for these analyses are presented in Table II; as the analysis of the negative stimuli yielded a significant two-way interaction, it is analyzed further below.

   To test the hypothesis that the two schizophrenia subgroups and the healthy controls differ in their arousal in their response to negative social and nonsocial stimuli, a 3 (Symptom group: HC, SLNS, SHNS) x 2 (Social content: social, nonsocial) repeated measures ANOVA was conducted using arousal to negative stimuli as the dependent variable. This analysis detected a main effect of group, $F(2, 88) = 6.24, p < .01$, but not a main effect of social content, $F(1, 88) = .06, ns$. However, these main effects were qualified by a significant group by social content interaction, $F(2, 88) = 3.55, p < .05$. Follow-up analyses of this interaction revealed that controls and SHNS did not differ in their arousal ratings of negative social stimuli, $t(38.42) = -.78, ns$, but both groups were less aroused by these stimuli than the SLNS, $t(59.67) = -3.68, p < .001$ and
\(t(31,80) = 2.46, p < .05\), respectively. However, a different pattern emerged in arousal ratings of the nonsocial negative stimuli; controls were still less aroused by the stimuli than SLNS, \(t(72) = -3.50, p = .001\), but the SLNS group did not differ from the SHNS group, \(t(30.71) = 1.78, \) ns. In sum, for social negative stimuli, the high negative symptoms group was less aroused by stimuli than the low negative symptoms group, while for nonsocial negative stimuli, the two symptoms groups did not significantly differ in their arousal ratings. Further, a regression analysis revealed that negative symptoms uniquely predicted arousal response, such that more negative symptoms predicted reduced arousal ratings of negative social but not nonsocial stimuli.³

2. Valence ratings

To test whether the three groups differed in their valence ratings to social and nonsocial stimuli based on the valence of the stimuli, a 3 (Diagnostic group: healthy controls, SLNS, SHNS) x 2 (Social content: social, nonsocial) x 3 (Valence: negative, neutral, positive) repeated measures ANOVA was conducted using valence ratings as the dependent variable. This ANOVA did not find a significant main effect of group, social content, or valence, or any significant interactions involving group.

³ A standard regression revealed that only negative symptoms uniquely predicted arousal ratings of negative social stimuli, \(\beta = -.68, t(37) = -3.44, p < .01\). Positive and depressive symptoms were not significant predictors. See Table III.
### TABLE III

**PREDICTORS OF AROUSAL RESPONSE TO NEGATIVE SOCIAL STIMULI**

<table>
<thead>
<tr>
<th>Predictors</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
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<tbody>
<tr>
<td>Positive Symptoms</td>
<td>0.02</td>
<td>0.03</td>
<td>0.09</td>
<td>0.52</td>
<td>0.61</td>
</tr>
<tr>
<td>Negative Symptoms</td>
<td>-0.12</td>
<td>0.03</td>
<td>-0.68</td>
<td>-3.44</td>
<td>0.00</td>
</tr>
<tr>
<td>Depression</td>
<td>0.01</td>
<td>0.02</td>
<td>0.06</td>
<td>0.30</td>
<td>0.76</td>
</tr>
<tr>
<td>Social Functioning</td>
<td>-0.02</td>
<td>0.02</td>
<td>-0.34</td>
<td>-1.49</td>
<td>0.15</td>
</tr>
<tr>
<td>Social Anhedonia</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.08</td>
<td>-0.48</td>
<td>0.63</td>
</tr>
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</table>
IV. DISCUSSION

Previous research addressing whether momentary emotional response in schizophrenia is intact has yielded mixed findings. This study sought to address this by hypothesizing that social content and symptom severity may help to explain the inconsistencies in the literature.

A. Momentary Differences in Emotional Experience

The results of this study indicated that while schizophrenic and control participants did not respond differently to social and nonsocial stimuli in general, differences were found when the valence of social/nonsocial stimuli and symptom severity in the SZ was considered. Specifically, healthy controls were more responsive to negative social than nonsocial stimuli, whereas individuals with schizophrenia tended to be more responsive to negative nonsocial than social stimuli. In addition, schizophrenia patients with low levels of negative symptoms reported greater arousal in response to all stimuli than did both control subjects and patients with high levels of negative symptoms.

One way to understand this finding is to consider that individuals with schizophrenia with low levels of negative symptoms may have an overactive arousal response to emotional stimuli. This hypothesis is supported by multiple studies that have shown that schizophrenia patients report a heightened arousal in response to emotional and neutral stimuli in comparison to healthy individuals (Monkul et al., 2007; Tremeau et al., 2009). Further, functional imaging studies have reported a heightened resting level activation of the amygdala in individuals with schizophrenia, in contrast to healthy subjects (Taylor, Phan, Britton, & Liberzon, 2005), as well as an increased activation to neutral faces (Hall et al., 2008), suggesting a higher baseline of emotional arousal. Previous studies have also found a negative correlation between amygdala activation and
severity of negative symptoms (Derntl et al., 2012), which may explain why heightened arousal was found only for schizophrenia subjects with relatively low levels of negative symptoms.

When the stimuli were broken down into levels of valence, differences emerged specifically in patterns of arousal response to negative social and nonsocial stimuli. These analyses found that while healthy controls were more aroused by social than nonsocial negative stimuli, the schizophrenic patients trended toward being more aroused by nonsocial than social negative stimuli. These distinct patterns of arousal response to social and nonsocial stimuli found in healthy controls and schizophrenia subjects may be explained in a number of ways.

First, prior research has indicated that individuals with schizophrenia exhibit deficits in the appraisal of social stimuli. In particular, it has been shown that schizophrenia patients are less accurate than comparison subjects in recognizing facial emotions (Bigelow et al., 2006; Hooker & Park, 2002; Turetsky et al., 2007). Further, psychophysiological studies have identified functional abnormalities in neural response to affective facial stimuli (Hempel, Hempel, Schonknecht, Stippich, & Schroder, 2003; Streit et al., 2001; Turetsky et al., 2007). Given evidence of impaired emotion recognition in schizophrenia, the dampened arousal response to social but not nonsocial stimuli may have been due to an inability to accurately interpret the content of the social stimuli.

A second possibility is that individuals with schizophrenia may have difficulty empathizing with individuals depicted in the social stimuli, resulting in reduced emotional response to negative social stimuli. Penn, Sanna, & Roberts (2008) noted that beyond deficits in emotion identification, individuals with schizophrenia often demonstrate impairments in the ability to make inferences about others’ intentions (also referred to as theory of mind). This impairment in perspective-taking may relate to reduced empathy in schizophrenia (Derntl et al.,
2009; Smith et al., 2012), as these empathic skills are important in developing normative emotional responses.

B. **Relationship between Symptoms and Responses to Social Stimuli**

Secondary analyses examining the relationship between clinical presentation in individuals with schizophrenia and momentary emotional responses to social and nonsocial stimuli revealed that negative symptom severity was uniquely predictive of momentary arousal responses to negative social stimuli. Further, other clinical characteristics, such as positive symptoms and depression, were not predictive of emotional response to any valence of stimuli.

The significant relationship between negative symptom severity and emotional response to negative social stimuli could help to account for inconsistent findings in the research literature regarding in-the-moment emotional experiences in individuals with schizophrenia. Indeed, findings discussed earlier in this paper indicate that individuals with high levels of negative symptoms do appear to be less aroused by stimuli than those with low levels of symptoms. Further, the results from this study suggest that individuals with schizophrenia tend to be more responsive to nonsocial than social stimuli. The current findings help to elucidate symptomatic factors that contribute to this difference.

C. **The Unique Role of Negative Stimuli**

The results of this study suggested a unique relationship between symptom presentation and emotional response to negative but not positive or neutral stimuli. Negative symptoms only predicted emotional response to negative (social) stimuli in the schizophrenia group, and control and patient groups only differed in their response patterns to negative (social and nonsocial) stimuli. Notably, the specificity of findings to negative stimuli is consistent with Burbridge and Barch’s (2007) work, which also found differences between schizophrenia and control groups
only in response to negative stimuli. Two potential explanations for this unique association with negative stimuli are outlined below.

First, compared to the positive and neutral stimuli, the negative stimuli were rated as significantly more arousing (see Table II). The IAPS arousal rating scales are designed to assess emotional response to a wide range of semantic categories on the dimensions of affective valence and arousal (Lang, Bradley, & Cuthbert, 1997). However, the relationship between valence and arousal is complicated: although strongly negatively valenced experiences are usually associated with high arousal, the relationship between positive valence and arousal is less clear. Norms for the IAPS stimuli suggest that both positive and negative stimuli are associated with higher arousal than neutral stimuli. However, the normative data indicated that while the set of positive stimuli included both highly and lowly arousing pictures, the negative stimuli were mainly clustered around the high arousal end of the spectrum. Given the lack of lowly arousing negative stimuli, it is not surprising that the negative stimuli as a whole were rated as more arousing than the positive (as well as neutral) stimuli. This is consistent with previous research that has shown negative stimuli to be more stimulating than positive or neutral stimuli (Neumann, Blairy, Lecompte, & Philippot, 2006).

Second, the content of the negative stimuli may have had an influence on its association with negative symptoms. Most of the negative slides contained fear-provoking images, such as aggressive scenes, weapons, or insects. Previous literature on the experience of fear in schizophrenia has indicated that schizophrenia patients exhibit reduced amygdala activation (Das et al., 2007) and abnormal superior temporal connectivity (Leitman et al., 2008) in response to fear stimuli. Further, Michalopoulou and colleagues (2008) found that neural activation in response to fearful facial expressions in a gender identification task was associated with
negative, but not positive, symptoms. This is consistent with the present study’s findings that more severe negative symptoms uniquely predict reduced emotional response to negative social stimuli.

Predicting response to negative social stimuli in particular is important because these responses may have an effect on the quality of these individuals’ social interactions. The ability to respond to and empathize with another individual’s pain or sadness is an important component of forming relationships, and impairments in this area can have debilitating effects (Darwin, 1872). Poor social functioning, as exemplified by reduced social engagement, is often a prominent feature of schizophrenia. A positive association between neural response to negative affective facial stimuli and social functioning has been found in individuals with schizophrenia (Pinkham, Loughead, Ruparel, Overton, Gur, & Gur, 2011). The results from this study indicate that while healthy controls are more aroused by negative stimuli with human content than without human content, individuals with schizophrenia appear to show the opposite pattern. This suggests that individuals with schizophrenia are not showing the heightened engagement with both positive and negative social stimuli that is found in healthy research participants. This diminished response to social stimuli could play a significant role in poor social functioning.

Without the ability to be preferentially engaged by social and emotional stimuli, an individual is less likely to seek out, develop, and maintain successful interpersonal relationships (Meehl, 1962). This, in turn, may result in a decrease in their exposure to social situations and decreased practice of interaction skills.

D. **Limitations and Future Directions**

Due to the cross-sectional nature of the data collection, these analyses cannot address the direction in causality in the relationship between clinical ratings and in-the-moment emotional
experiences. Given that we are aiming to measure emotional experience, which in itself is subjective, self-report assessments can provide useful information. However, some may argue that collecting only self-report data is problematic in this population because insight into feelings may be limited. Objective measures of arousal, such as skin conductance, heart rate, or eye blink startle response may be useful to complement data collection in future studies.

Another limitation was the relatively small sample sizes (38 SZ were divided into 17 SHNS and 21 SLNS, in contrast to 53 HC) used in statistical analyses. Using small sample sizes limits the statistical representation of the population, and reduces the power of the study to find statistically significant results, which limits the conclusions that can be drawn from the data. Future research would benefit from using greater sample sizes of schizophrenia subgroups to maximize the chances of finding significant differences or relationships when they exist.

In addition, some may argue that dichotomously classifying individuals into groups with high and low levels of negative symptoms may have limited our results, because it required us to convert negative symptom severity from a continuous to a categorical variable. However, we also conducted secondary analyses using the continuous form of the negative symptom severity variable to predict emotional ratings, and this approach yielded similar results (i.e., stronger negative symptoms predicted decreased arousal). This suggests that the use of a categorical in contrast to a continuous variable approach did not significantly affect our results.

Lastly, the “in-the-moment” ratings of social emotional experiences were based entirely on viewing pictures with human content, rather than having the participants experience actual social interactions. Subjects’ reported responses to the IAPS social stimuli were meant to serve as a proxy for their responses in real social interactions. Although we found significant effects of social in contrast to nonsocial stimuli on arousal ratings in this sample, studies assessing in-the-
moment experiences of schizophrenia patients and healthy controls during actual social interactions would be useful. Studies addressing this issue are in progress in our lab.

E. **Conclusion**

While some studies have found that momentary emotional response is intact in schizophrenia relative to controls (Gard et al., 2007; Hempel et al., 2005; Herbener et al., 2008; Horan et al., 2006), others have found group differences on emotional response (Burbridge & Barch, 2007; Dowd & Barch, 2010). This study sought to address these inconsistencies by examining the impact of symptom severity and social content on these experiences.

This study found that negative symptoms do, in fact, play an important role in momentary emotional experience in schizophrenia. Overall, the findings revealed that among schizophrenic individuals, greater negative symptom severity predicts decreased arousal in response to negative social stimuli. Given that heterogeneity of symptom presentation in schizophrenia may complicate results, symptom severity (particularly negative symptoms) should be considered when analyzing emotional response in schizophrenia.

Further, social content also appears to modulate emotional response to IAPS stimuli, as our results also indicated that healthy controls appear to be more aroused by images with social than nonsocial content, whereas both schizophrenia groups are more aroused by nonsocial than social stimuli. This opposite pattern of response to social and nonsocial stimuli in the patient and control groups highlights the importance of taking into account social content when designing studies of emotional response in schizophrenia.
CITED LITERATURE


Approval Notice
Continuing Review (Response To Modifications)

August 26, 2011

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Psychiatry
912 S. Wood St.
136 N.P.I.-S, M/C 913
Chicago, IL 60612
Phone: (312) 413-2638 / Fax: (312) 413-4122

RE: Protocol # 2003-0622
“Emotional Functioning in Schizophrenia Spectrum Disorders and Depression”

Dear Dr. Herbener:

Your Continuing Review (Response To Modifications) was reviewed and approved by the Expedited review process on August 23, 2011. You may now continue your research.

Please note the following information about your approved research protocol:

Please note that the amendment form included with the response to modifications, removing research personnel, was administratively withdrawn, as it was not logged in at the time of submission. However, the personnel were removed as part of the continuing review.

Approved Subject Enrollment #: 300 (Data Analysis Only)
Additional Determinations for Research Involving Minors: The Board determined that this research satisfies 45CFR46.406; research involving greater than minimal risk (representing a minor increase over minimal risk) and having no direct benefit to the individual subjects, but likely to yield generalizable knowledge about the subjects condition. In accordance with 45CFR46.408, both parent's permission/signature (two signature lines needed) is required unless one parent is deceased, unknown, incompetent, or not reasonably available, or when only one parent has legal responsibility for the care and custody of the child.
Performance Sites: UIC
**Sponsor:** National Institutes of Health  
**PAF #:** 2003-04409  
**Grant/Contract No:** 1 K23 MH067223  
**Grant/Contract Title:** Affective Deficits in Schizophrenia  

**Research Protocol:**  
a) "Emotional Functioning in Schizophrenia Spectrum Disorders and Depression," Version #7, 05/05/2008

**Consent/Parental Permission/Assent/HIPAA Authorization, and Recruitment:**  
a) N/A – study is closed to enrollment

Your research meets the criteria for expedited review as defined in 45 CFR 46.110(b)(1) under the following specific category:

(8c) Continuing review of research previously approved by the convened IRB where the remaining research activities are limited to data analysis.

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Please remember to:

→ Use your research protocol number (2003-0622) on any documents or correspondence with the IRB concerning your research protocol.

→ Review and comply with all requirements on the enclosure, "UIC Investigator Responsibilities, Protection of Human Research Subjects"

Please note that the UIC IRB has the right to seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

Please be aware that if the scope of work in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact OPRS at (312) 996-1711 or me at (312) 355-2764. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,
Betty Mayberry, B.S.
IRB Coordinator, IRB #3
Office for the Protection of Research Subjects

Subjects

Enclosures:

1. UIC Investigator Responsibilities, Protection of Human Research Subjects
2. Data Security Enclosure

cc: Anand Kumar, Psychiatry, M/C 912
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