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PATTERNS OF EMOTIONAL EXPERIENCE IN SCHIZOPHRENIA: DIFFERENCES IN EMOTIONAL RESPONSE TO VISUAL STIMULI ARE ASSOCIATED WITH CLINICAL PRESENTATION AND FUNCTIONAL OUTCOME

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Abstract

The current study examined whether patterns of emotional response are differentially associated with symptom presentation and functional outcome in individuals with schizophrenia. Participants included 49 outpatients with schizophrenia and 50 demographically matched controls. All participants rated their emotional response to 131 images from the International Affective Picture Systems (IAPS) library on both arousal and valence scales. Stimuli were split into categories of positive versus negatively valenced stimuli based on control subject ratings. Cluster analysis was used to assess whether there were reliably distinct patterns of emotional response within the patient sample. Follow-up discriminant function analysis indicated that these groups were adequately separated. Sixty percent of the individuals with schizophrenia rated valence and arousal similarly to healthy subjects, while 40% displayed an atypical profile. Schizophrenia subgroups classified by these two emotional response styles significantly differed on measures of functional outcome, severity of negative symptoms, and self-reported anhedonia. Findings are discussed in relation to current theories of emotional experience in schizophrenia.

Keywords

Schizophrenia; Emotion; Anhedonia; Negative Symptoms; Functional Outcome

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Contributors

Dr. Herbener designed the study, wrote the IRB protocol, and clinically tested all participants. Data collection was performed by research assistants at the University of Illinois, Chicago. Dr. Strauss performed statistical analyses and wrote the first draft of the manuscript while completing his Clinical Internship at the University of Illinois, Chicago Department of Psychiatry. Subsequent drafts of the manuscript were edited by Drs. Strauss and Herbener. Both authors contributed to and have approved the final manuscript.

Conflict of interest

The authors have no conflicts of interest.

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1. Introduction

Affective disturbance has long been posited to be a core feature of schizophrenia. Early clinical conceptualizations of the subjective emotional state of individuals with schizophrenia were based largely upon the observation that patients displayed “blunted” or “flat” facial and vocal affect, which was taken to reflect a correspondingly diminished inner experience (Kraepelin, 1919). At present, it is well substantiated that many patients do indeed display a reduced capacity to express emotion; however, available data suggests that their subjective inner experience of emotion is not diminished (Herbener et al., 2007, 2008; Berenbaum & Oltmanns, 1993; Aghevli, Blanchard, & Horan, 2003; Earnst & Kring, 1999; Kring et al., 1993; Kring & Neale, 1996).

Aberrant emotional experience has been reported in a minority of studies using laboratory-based paradigms that require patients to rate smells (Doop & Park, 2006; Strauss et al., 2010), film clips (Earnst & Kring, 1999; Kring et al., 1993; Kring & Neale, 1996; Henry et al., 2007), and photographs (Curtis et al., 1999; Lee et al., 2006; Reske et al., 2007; Quirk et al., 1998; Schneider et al. 1995). However, the vast majority of laboratory-based experiments yield a consistent set of findings suggesting that momentary emotional experience is essentially normal in schizophrenia. Specifically, a number of studies have found that patients and controls do not differ in their ratings of a variety of affective stimuli with regard to how they assign momentary valence and arousal ratings (see Kring & Moran, 2008 for recent review; see Cohen & Minor, 2010 for recent meta-analysis).

Further, previous studies have indicated that patient self-report of affective experience has been found to have high internal consistency (Horan, Kring, Blanchard, 2006; Blanchard, Mueser, Bellack, 1998), adequate test-retest reliability (Blanchard, Mueser, Bellack, 1998), and an underlying valence-arousal structure that is similar to controls (Kring, Barrett, Gard, 2003). Thus it is unlikely that the discrepant findings in the affect literature are due to methodological concerns. It simply appears that the vast majority of schizophrenia studies indicate that patients rate emotionally evocative stimuli similarly to controls.

Although the majority of published studies indicate that patients rate emotional stimuli similarly to controls, it is still possible that variability in findings among published studies is due to the existence of a sub-group of SZ patients who have atypical emotional responses to emotional stimuli. The existence of such a sub-group, if relatively small in proportion, might explain why the majority of laboratory-based studies find no differences between patients and controls with regard to emotional experience, while a minority of studies report abnormal valence and arousal ratings (Kring & Moran, 2008). In order to assess this possibility, the current study uses a data-driven approach to determine whether there are subgroups of individuals with schizophrenia who have different responses to emotional stimuli. A second, important issue, is clarifying *how* the groups differ in their emotional response to affective stimuli. A number of recent studies have suggested that individuals with schizophrenia are not necessarily less responsive to positive aspects of emotional stimuli, as was initially posited in theories of anhedonia, but rather that they may have more mixed or ambivalent responses to emotional stimuli than healthy subjects (e.g., Strauss et al., 2010; Cohen & Minor, 2010; Treméau et al., 2009). In order to address this issue, we assessed whether schizophrenia subgroups differ in their tendency to have “atypical” responses to emotional stimuli, and if so, in what particular way (e.g., do they rate pleasant stimuli as being more unpleasant than controls)? As averages obscure this kind of information, we include analysis of differences in emotional response to address this question. We also examined whether sub-groups of patients identified by their patterns of emotional experience differ with regard to external validators (e.g., functional outcome,

symptoms) not used clustering procedures to determine whether the sub-groups are associated with meaningful clinical outcomes.

2. Method

2.1. Participants

Forty-nine individuals meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder and 50 healthy controls participated in the current study. Subjects were excluded from participation if they reported histories of head trauma with loss of consciousness greater than 15 minutes, substance dependence (past 6 months), or neurological or systemic illness that might affect central nervous system functioning. The Structured Clinical Interview for DSM-IV (First et al., 1997) was used to establish diagnoses for all participants. Schizophrenia patients (SZ) and Healthy Controls (CN) did not significantly differ in age (SZ $M = 37.2$, $SD = 10.9$; CN: $M = 37.8$, $SD = 11.1$; $F = 0.90$, $p = .77$), education (SZ $M = 13.8$, $SD = 4.0$; CN: $M = 13.6$, $SD = 2.2$; $F = 0.10$, $p = .75$), parental socioeconomic status (SZ $M = 34.1$, $SD = 14.5$; CN: $M = 35.3$, $SD = 12.4$; $F = 0.18$, $p = .67$), race (SZ: 27.3% Caucasian; CN: 29.4% Caucasian; $F = 2.4$, $p = .67$), or sex (SZ: 48% male; CN: 50% male; $\chi^2 = 0.85$, $p = .50$). Patients and controls did differ on Wechsler Abbreviated Scale of Intelligence estimated IQ (WASI; Wechsler, 1995) (SZ $M = 90.6$, $SD = 25.4$; CN: $M = 101.2$, $SD = 15.8$; $F = 4.6$, $p = .04$), where patients had significantly lower IQ scores than CN. All individuals with schizophrenia were clinically stable outpatients. The majority of SZ patients were prescribed second-generation antipsychotic medications (73%) and 12% were taking conventional antipsychotic medications at the time of evaluation. A subsample of these patients were included in our previous study that examined different aspects of affective disturbance in SZ (Herbener et al., 2008). Research procedures conformed with ethical criteria proposed by The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving human participants and were approved by the University Institutional Review Board.

2.2. Measures

2.2.1. Emotional responses to visual stimuli—One hundred and thirty one images from the International Affective Picture System (IAPS; Lang, 2001) were selected for emotional experience ratings¹. Stimuli were chosen to sample a wide range of both valence and arousal conditions, and thus included stimuli sampling the range between positive and negative valence, as well as low and high arousal. None of the stimuli contained content that could be considered offensive, such as sexually explicit images, mutilation images, or burn images. Written and verbal instructions asked participants to rate each IAPS image in terms of how it made them feel. Ratings were made using the Self-Assessment Manikin procedure, which was used in the original IAPS validation study. Using this procedure valence is rated on a 1–9 scale with 1 representing extremely negative and 9 extremely positive, and arousal is rated on a 1–9 scale with 1 indicating calming, quiet and 9 representing exciting, agitating.

2.2.2. Clinical assessments—In addition to the aforementioned laboratory-based measures of emotional experience, several clinical ratings scales were completed to assess

¹IAPS stimuli used in the current study included images: 1022, 1040, 1052, 1070, 1113, 1120, 1200, 1201, 1300, 1321, 1390, 1450, 1460, 1560, 1602, 1603, 1610, 1620, 1710, 1750, 1850, 1930, 1931, 1945, 2000, 2091, 2110, 2120, 2130, 2141, 2160, 2221, 2240, 2270, 2276, 2280, 2304, 2320, 2340, 2360, 2370, 2391, 2480, 2485, 2490, 2495, 2501, 2514, 2590, 2722, 2800, 2810, 2830, 2900, 3230, 3250, 3300, 3350, 4534, 4535, 4571, 4598, 4609, 4641, 4689, 5201, 5629, 5779, 5820, 5830, 5870, 5891, 5920, 5940, 5950, 5971, 5972, 6212, 6260, 6312, 6370, 6560, 6821, 6940, 7230, 7283, 7285, 7325, 7390, 7460, 7496, 7545, 7595, 7640, 8010, 8030, 8034, 8080, 8160, 8170, 8180, 8185, 8190, 8200, 8280, 8370, 8400, 8420, 8470, 8490, 8501, 8531, 9001, 9050, 9080, 9120, 9210, 9220, 9250, 9280, 9331, 9340, 9470, 9530, 9560, 9582, 9600, 9622, 9630, 9800, 9910

severity of clinical symptoms and global functional outcome. Symptomatology relevant to schizophrenia was assessed using the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987). The Heinrichs-Carpenter Quality of Life Scale (H-C QOL; Heinrichs, Hanlon, Carpenter, 1984), was completed as a measure of functional outcome to assess patients on four domains of functioning: social activity (Interpersonal Scale), productive activity either in the workplace or at home (Instrumental Scale), use of objects and participation in common activities (Common Scale), and intrapsychic functioning as indicated by motivation, anhedonia, curiosity, and empathy. The Chapman Anhedonia Scales (Chapman, Chapman, Raulin, 1976) were also administered to all patients as an index of self-reported subjective emotional experience. This scale measures two aspects of emotional experience—physical and social anhedonia. The physical anhedonia scale examines the extent to which patients report that they have experienced pleasure from various physical sensations, while the social anhedonia scale examines the degree to which patients report that they have experienced pleasure during social interactions.

2.3. Procedures

The current tests were administered as part of a larger battery of clinical, affective, and neuropsychological measures. Testing procedures generally took place over 2 days, with each session generally lasting from 1-3 hours and breaks were allowed as needed to diminish fatigue and maintain motivation. For all subjects, demographic, diagnostic, and symptom ratings were administered by a licensed clinical psychologist (ESH), while all experimental tasks were administered by a research associate.

2.4. Data Analysis

The current study aimed to determine whether: 1) subgroups of patients with schizophrenia can be identified based upon differences in their reported emotional responses to positive and negatively valenced images, 2) subgroups of schizophrenia patients evidencing different patterns of emotional response also differ on relevant demographics, severity of schizophrenia-related symptoms, and functional outcome (i.e., external validators of cluster solutions).

To achieve these aims the following series of analytical techniques were performed. First, stimuli were split into categories of positive vs. negatively valenced images based on median scores from the control subjects. Since the stimuli used in the current analyses were selected to sample the full range of valence and arousal available in the IAPS image library, this approach is justifiable. The correlation between valence ratings of the IAPS images by control subjects in this study and published normative data on the IAPS was high, $r = 0.96$, $p < 0.001$. Second, mean valence and arousal ratings for the positive and negative stimuli were calculated for each subject. These scores were submitted to cluster analysis using Ward's method and squared Euclidean distance to assess whether there was evidence of reliable subgroups within the patient sample. Ward's method was selected because it generates results that are consistent with other agglomerative clustering methods, and because it is less affected by outliers than other clustering methods. The selection of a strategy capable of reducing the impact of outliers was important for the current study given that the sample size consisted of 49 patients, and we wanted to avoid the detection of clusters with small numbers of subjects that would be influenced by extreme cases. Squared Euclidean distance was selected as the dissimilarity measure because it is the most widely used dissimilarity measure applied in cluster analysis (Everitt, Landau, & Leese, 2001). In the absence of objective methods for determining the definitive number of clusters, we followed recommendations based upon the seminal text by Aldenderfer and Blashfield (1984) and more recent texts (Everitt, Landau, & Leese, 2001). This consisted of evaluating the optimal number of clusters using multiple methods. We initially conducted preliminary cluster

analyses with varying numbers of cluster solutions to identify trivial clusters in a manner similar to “scree testing”. Next, we examined the distance between group centroids to determine whether there was adequate separation among clusters identified in the various solutions. These heuristic strategies do not rule out alternative cluster solutions. However, they do provide indication of the point at which further clustering is not productive because of reduced distance among the cluster spaces. Next, we examined the stability of the cluster solution structure by comparing a hierarchical agglomerative method (i.e., Ward’s) and an iterative partitioning method (i.e., K-means). Cohen’s Kappa was used to determine the agreement between the K-means and Ward’s method solutions. This analysis allowed us to determine if similar clusters were present regardless of the algorithm used to derive them. Finally, visual inspection of the dendrogram plot resulting from cluster analysis was also used to confirm the optimal number of clusters. Mean ratings of emotional responses to valence and arousal characteristics of the stimuli were compared among the clusters obtained in the optimal solution.

Third, to confirm differences between the clusters, the valence and arousal ratings for positive and negative stimuli were entered into a discriminant function analysis where clusters identified in the cluster analysis served as the grouping variable. An iterative partitioning method was applied within the discriminant function analysis to determine cluster stability. Using this iterative method, a large number of cluster reassignments would suggest poor stability of cluster classification.

Fourth, ANOVAs, MANOVAs, Kruskal-Wallis H, and Chi-square analyses were calculated to examine potential differences among patient clusters on relevant demographic, symptom, and functional outcome variables. Effect size is reported in terms of η^2 (0.01 = low; 0.06 = medium; 0.14 = large). Similar cluster analysis and discriminant function procedures have been used in other studies examining heterogeneity in schizophrenia (e.g., Goldstein et al., 2002, 2005).

3. Results

3.1. Do sub-groups of patients exist that significantly differ in valence and arousal ratings?

Visual inspection of the dendrogram indicated that a two-cluster solution was reasonable, as 2 distinct clusters could be identified (see Figure 1). The selection of the two-cluster solution was supported by analyses indicating good agreement between Ward’s method and the K-Means clustering ($\kappa = 0.79$, $p < 0.001$). Agreement was less satisfactory for three and four cluster solutions, which also did not have enough cases to be considered meaningful. Support for a 2-cluster solution was also found after clusters were plotted in multidimensional space, as separation among cluster centroids was clear for the two-cluster solution, but not as clear for the three and four cluster solutions. These multiple methods thus converged to indicate that a 2-cluster solution was optimal.

Means and standard errors were calculated for each group to determine the meaning of clusters obtained. Mean valence and arousal ratings of the IAPS stimuli are plotted in Figure 2. As can be seen in Figure 2, cluster 1 ($n = 30$) reflected a group who was relatively normal with regard to momentary affective experience, i.e., valence and arousal ratings made by Group 1 for both pleasant, neutral, and unpleasant images were nearly identical to ratings made by the CN group. Cluster 1 therefore appears to represent a group of schizophrenia patients with relatively normal emotional experience. Cluster 2 ($n = 19$) reflected a group of patients who differed from controls with regard to momentary valence and arousal ratings, and who reported that negative stimuli were more unpleasant and arousing than controls and other patients. No differences were noted for this cluster with regard to rating the valence or arousal of pleasant stimuli.

3.1.3. Are emotional experience sub-groups valid?—When valence and arousal ratings were entered in discriminant function analysis, results indicated that the 2 cluster solution (see Figure 3) was adequately separated in discriminant function space. An iterative partitioning method was also applied to examine cluster stability. Results of this iterative method indicated that 95.9% of cases were correctly classified (Wilks' Lambda = 0.36, $p < .001$). These results indicate that there is little overlap in valence and arousal ratings made among the patient clusters identified. Thus, results are supportive of the notion that a sub-group of patients exist who experience emotion atypically, even though the majority of patients experience emotion similarly to controls.

3.2. How do sub-groups differ in their momentary valence-arousal ratings?

Recent studies have suggested that affective disturbance in SZ might not reflect a simple hedonic impairment, but rather a tendency to experience positive stimuli as being aversive (Cohen & Minor, 2010; Kring & Moran, 2008; Treméau et al., 2010). To assess whether this was true of the subjects in our study, we assessed how frequently individuals in the two SZ subgroups and CN subjects reported an emotional response that was unusual (e.g., reported a negative emotional responses to a positive stimulus, or a positive emotional response to a negative stimulus). For this analysis, we assessed the frequency with which subjects reported an emotional response that was consistent with the “normative” response: specifically, we calculated the proportion of items subjects rated that were consistent with normative values for the stimuli based on categories of positive (ratings of 1-3), neutral (ratings of 4-6) and negative (ratings of 7-9) stimuli. Analyses were conducted separately for positive and negative stimuli using the Kruskal-Wallis H test because the % of items rated in each of the categories is not independent.

Statistical analyses focused on the consistency between normative ratings and subject ratings. For “normatively positive” stimuli, results indicated that the 3 groups significantly differed in the % of positive stimuli rated in the unpleasant range of the valence scale ($\chi^2 = 11.88$, $p = 0.003$), but not for the percentage of items rated in the pleasant range or neutral ranges. Post hoc Scheffe tests indicated that cluster 2 rated a significantly greater proportion of positive items in the unpleasant range of the valence scale than either the CN group ($p = .007$) or cluster 1 ($p = .001$) (see Figure 4).

For “normatively negative” stimuli, groups significantly differed in the % of negative stimuli rated in the unpleasant ($\chi^2 = 8.63$, $p = 0.013$) and neutral ranges ($\chi^2 = 14.07$, $p = 0.001$), but not in the pleasant range. Post hoc Scheffe contrasts indicated that cluster 2 rated a higher proportion of negative items as falling in the unpleasant range and fewer negative items as falling in the neutral range than CN and the emotionally normal patient group (see Figure 5).

3.4. Do patient clusters differ on relevant demographic and clinical characteristics?

A series of one-way ANOVAs and Chi-Square analyses were conducted to examine differences in clinical and demographic variables for the two patient subgroups. As shown in Table 1, analyses indicated that the 2 patient clusters did not significantly differ on demographic variables; however, there was a trend indicating a lower WASI full-scale IQ in cluster 2.

3.5. Do patient clusters differ on measures of symptom severity?

Separate MANOVAs were conducted to examine the effects of group membership on PANSS symptom severity and Chapman Scale Anhedonia. In the first set of MANOVAs, PANSS positive, negative, and general scale factors served as dependent variables. In the second set of MANOVAs, Chapman scale physical and social anhedonia served as

dependent variables. One-way ANOVAs were also calculated to determine whether the 2 patient clusters differed on the PANSS total score and Chapman total anhedonia score.

MANOVA indicated a significant main effect of group with PANSS scores serving as the dependent variable, $F(1, 47) = 3.45, p = .02 (\eta^2 = .24)$, signifying differences in symptom severity between the 2 patient clusters. Significant between-subjects effects were observed for the PANSS negative symptom factor ($F = 8.39; p = .006$), with individuals in cluster 2 demonstrating higher levels of negative symptoms than individuals in cluster 1. However, no significant difference was found between groups for the PANSS positive and general symptom factors (Table 2).

MANOVA also indicated that the 2 patient clusters significantly differed on Chapman Scale Physical Anhedonia, $F(1, 46) = 4.23, p = .02$, with patients in cluster 2 indicating significantly higher levels of Physical Anhedonia than patients in cluster 1. The two groups did not significantly differ on Hamilton Depression scale severity. Thus, the two patient clusters appear to differ primarily on negative symptoms, with cluster 2 evidencing a greater severity of negative symptoms.

3.6. Do patient clusters differ on functional outcome?

MANOVA was conducted to examine the effects of group membership on functional outcome. HCQL Instrumental Role, Interpersonal Relations, Intrapsychic Foundations, and Common Objects and Activities scores served as dependent variables. Mean HCQL scores are presented in Table 2. MANOVA indicated that the overall effect of group was significant for HCQL functional outcome, $F(4, 44) = 2.72, p = .04 (\eta^2 = .24)$. Significant individual effects were found for the Instrumental Role Functioning ($p = .004$) and Common Objects and activities ($p = .009$) subscales. The Intrapsychic Foundations subscale approached significance ($p = .087$). As can be seen in Table 2, cluster 1) displayed significantly better overall functional outcome than cluster 2.

4. Discussion

Given that many studies of emotional experience in schizophrenia have documented generally normal emotional response, while a substantial minority has documented abnormal emotional responses, the current study considered the possibility that there are subgroups within schizophrenia samples which differ in their emotional experience. A data-driven approach was taken to address this question, using cluster analysis to identify subgroups and discriminant function analysis to confirm the effectiveness of the cluster solution in differentiating subgroups.

4.1. Distinct sub-groups of emotional experience exist in SZ and they are associated with clinically meaningful outcomes

Our results indicated that while the majority of individuals with schizophrenia did report emotional responses to stimuli that were quite similar to those of healthy subjects (~60%), there were a minority of patients who showed an atypical pattern of response (~40%). The potential importance of this distinction was indicated by data demonstrating that patient subgroups differed on relevant clinical and functional outcome measures. Specifically, the emotionally atypical cluster displayed more severe symptoms on the PANSS Negative Symptom Scale and the Chapman Anhedonia Scale, as well as more functional impairment on the HCQL.

4.2. What is different about emotional response in SZ?

Analyses were also conducted to examine specific patterns of valence and arousal observed in SZ. The emotionally atypical group of patients rated negative stimuli as being more negatively valenced and more arousing than the CN group and the emotionally normal patient cluster; however, the group average data did not indicate abnormalities in emotional response to positive stimuli. Consistent with what other investigators have recently proposed (e.g. Cohen & Minor, 2010), patients therefore do not appear to display a primary hedonic deficit (i.e., experiencing positive stimuli as being less pleasant).

In an effort to further understand *how* emotional responses varied in the “emotionally atypical” schizophrenia group, we assessed the frequency with which the subjects apportioned their ratings of Positive and Negative stimuli as falling within each range of the valence scale (i.e., what % of positive stimuli were rated as being highly pleasant, neutral, or highly unpleasant). Results indicated that the affectively atypical schizophrenia subjects were more likely to report that “normatively” positive images elicited negative emotional responses than were “affectively normal” schizophrenia subjects. Notably, the two schizophrenia groups and the CN group did not differ in their frequency of rating “normatively” positive stimuli as eliciting a neutral response. With regard to negative stimuli, the emotionally atypical cluster rated a greater proportion of “normatively” negative images as falling in the unpleasant range, and fewer images as falling in the neutral range in comparison to CN; however, groups did not differ on the percentage of negative stimuli rated as falling in the pleasant range. These findings are consistent with previous studies, which have used both unipolar (see Cohen & Minor, 2010 and bipolar (e.g., Strauss et al., 2010) scales to show evidence that patients experience positive stimuli as being aversive and provide evidence that these abnormalities are unique to patients who experience emotion atypically. When all of these analyses are considered together, the patterns of response seen in patients in the atypical cluster are characterized by: 1) rating negative stimuli as more unpleasant and more arousing than controls, and 2) rating positive stimuli in the unpleasant valence range more frequently than controls. In this sense, the patients in this cluster display both an “atypical” pattern of emotional response, as well a tendency toward rating negative stimuli more intensely.

4.3. Limitations and Future Directions

Our results should be considered in the context of certain limitations. First, the sample size in this study consisted of 49 patients which constricts the number of clusters that can be identified. It is possible that much larger sample sizes would result in the identification of more clusters than what was found optimal in the current study; however, our results suggest that such sample sizes would need to be very large (> 200) to allow for enough cases for a 3 or 4 cluster solution to be considered meaningful. Nonetheless, it is possible that much larger samples could identify further subgroups within the emotionally atypical cluster identified here, which would be of considerable interest. Second, results of the current study are limited to the types of stimuli used. We did not incorporate some of the more intense IAPS images reflecting erotica and mutilation; however, such stimuli may be more likely to result in larger individual differences in arousal ratings and thus may lead to different findings. Finally, cluster analysis is best considered an exploratory method intended for generating hypotheses, rather than a means of testing hypotheses, since inferences made from the technique are sample dependent. It will be important to replicate the cluster solution obtained on other datasets as further indication that the subsets of patients identified are not simply artifacts. To this end, it should be kept in mind that clustering techniques performed across different samples will likely result in some variability in the number of clusters identified and the proportion of individuals in those groups, but if the pattern of results found in the current study is replicated, this would be of importance to the field.

Future studies could extend the current findings by examining “ambivalence” using unipolar valence rating scales, where subjects separately rate how pleasant and unpleasant each stimulus makes them feel. Recent meta-analyses and reviews indicate that one of the major affective deficits exhibited by patients is rating neutral and pleasant stimuli as being unpleasant, and sometimes more arousing (Cohen & Minor, 2010; Kring & Morna, 2008). In the current study we found some evidence for these abnormal response patterns using a bipolar rating scale; however, it will be important to extend these results to unipolar rating scales as well. Alternatively, research on healthy individuals shows critical differences in the subjective experience and physiological response to stimuli classified in relation to “motivational significance” (Bradley et al., 2001). Patient response to stimuli reflecting differing levels of “motivational significance” has not been evaluated in schizophrenia, but may represent an important future direction.

4.4. Implications for Research on Emotion in SZ

The current findings have several important implications for conducting emotion research in individuals with SZ. First, results are consistent with prior studies indicating that the majority of individuals with SZ do not have abnormal responses to emotional stimuli. This may explain why the majority of studies examining emotional response in SZ indicate that patients and controls show little difference in valence and arousal ratings (Cohen & Minor, 2010; Kring & Moran, 2008), while a minority of studies find that patients rate stimuli abnormally. Given that only approximately 40% of individuals with SZ experience emotion atypically, it will be beneficial to collect data on large samples that have sufficient power to detect group differences. Also of importance was that results did not support a primary hedonic deficit in schizophrenia (i.e., rating positive stimuli as less pleasant). Rather, data suggested that atypical emotional response is mostly associated with experiencing negative stimuli as being highly unpleasant and arousing, as well as rating positive stimuli as being aversive. Future work is needed to determine whether such abnormalities reflect tonic elevations in negative mood that color the evaluation of all stimuli, or difficulties down-regulating negative emotion after being exposed to an evocative stimulus. Recent methods developed in the field of affective neuroscience, as well as theoretical frameworks developed by schizophrenia researchers like Cohen (Cohen & Minor, 2010; Cohen, Minor, & Najolia, 2010) and Tremeau (Tremeau et al., 2009) and colleagues, which postulate roles for affective ambivalence and co-activation of positive and negative brain circuits, offer promising new avenues for exploring atypical emotional response.

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Figure 1.
Cluster Analysis Dendrogram

Figure 2.
Means and Standard Errors for IAPS Valence and Arousal Ratings for Patient Clusters

Figure 3.
Patient 2 Cluster Solution Plotted in Discriminant Function Space

Figure 4. Means Percentage of Positive items rated in Pleasant, Unpleasant, and Neutral Ranges of the Valence Scale

Figure 5.
Means Percentage of Negative items rated in Pleasant, Unpleasant, and Neutral Ranges of the Valence Scale

Table 1

Demographics for Patient Clusters

2 Cluster Solution			
	1 (n = 30)	2 (n = 19)	p-value
Age	36 (10.8)	39 (11.3)	$p = .47$
Education	14.5 (4.5)	12.9 (2.5)	$p = .18$
WASI Full-Scale IQ	98.2 (20.6)	88.2 (15.95)	$p = .10$
Patient Total SES	34.1 (12.4)	34.0 (15.5)	$p = .97$
Parent Total SES	37.7 (15.2)	33.8 (14.3)	$p = .45$
Total # of Psych Hosp	6.69 (7.5)	6.75 (12.3)	$p = .99$
% Conventional	17%	05%	$p = .25$
% Atypical	70%	79%	$p = .28$
% Male	50.0%	47%	$p = .57$
% Caucasian	27%	16%	$p = .54$

Table 2

Means and Standard Deviations for Symptom Measures and Functional Outcome Among Patient Clusters

	1 (n = 30)	2 (n = 19)	<i>p</i>-value
Symptom Severity			
PANSS Negative Subscale	13.6 (04.4)	18.36 (6.12)	<i>p</i> = 0.01
PANSS Positive Subscale	15.9 (05.1)	15.86 (4.20)	<i>p</i> = 0.99
PANSS General Subscale	31.0 (7.3)	33.00 (6.03)	<i>p</i> = 0.59
PANSS Total	60.5 (12.5)	67.21 (12.40)	<i>p</i> = 0.28
Chapman Scale Social Anhedonia	12.9 (06.6)	17.86 (7.40)	<i>p</i> = 0.12
Chapman Scale Physical Anhedonia	14.6 (06.4)	20.50 (8.45)	<i>p</i> = 0.05
Chapman Scale Total Anhedonia	28.2 (11.6)	40.43 (13.59)	<i>p</i> = 0.01
Hamilton Depression Scale Total	08.6 (07.3)	10.43 (7.65)	<i>p</i> = 0.63
Functional Outcome			
HCQL Instrumental Role	14.0 (04.4)	14.50 (3.37)	<i>p</i> = 0.70
HCQL Interpersonal Relations	30.8 (11.7)	22.07 (10.07)	<i>p</i> = 0.02
HCQL Intrapsychic Foundations	29.0 (07.9)	24.43 (6.32)	<i>p</i> = 0.06
HCQL Common Objects & Activities	08.1 (02.4)	07.64 (1.86)	<i>p</i> = 0.56
HCQL Total	81.9 (22.6)	68.64 (17.39)	<i>p</i> = 0.05