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Does Anhedonia in Schizophrenia Reflect Faulty Memory for Subjectively Experienced Emotions?

William P. Horan
University of California, Los Angeles

Michael F. Green
University of California, Los Angeles, and Veterans Affairs Greater Los Angeles Healthcare System

Ann M. Kring
University of California, Berkeley

Keith H. Nuechterlein
University of California, Los Angeles

The authors evaluated whether self-reported trait anhedonia in schizophrenia reflects faulty memory, such that patients are capable of experiencing pleasure while engaged in enjoyable activities but underestimate their pleasure in recalling these experiences. Thirty schizophrenia patients and 31 nonpatient control participants rated their emotional responses to pleasant and neutral foods and film clips and completed a surprise recall task for their emotions after a 4-hr delay. Despite reporting elevated trait anhedonia, patients did not significantly differ from control participants in immediate pleasant emotional responses to the stimuli or in delayed recall for these experiences. In-the-moment pleasure and short-term retention for emotional experiences thus appear to be relatively intact in schizophrenia. Alternative explanations for the hedonic deficit in this disorder are discussed.

Keywords: schizophrenia, emotion, anhedonia, memory

Anhedonia, the diminished ability to experience pleasure, has historically been regarded as a core clinical feature of schizophrenia (Meehl, 1962; Rado, 1962) and is associated with the functional impairment that characterizes this disorder (Blanchard & Panzarella, 1998). Despite the clinical significance of anhedonia, research on this emotional disturbance has produced a somewhat paradoxical set of findings, raising fundamental questions about its nature. On the one hand, individuals with schizophrenia typically report experiencing lower levels of pleasure in their daily lives than nonpatients on self-report measures of trait social and physical anhedonia (Blanchard, Horan, & Brown, 2001; Blanchard, Mueser, & Bellack, 1998; Herbener & Harrow, 2002). On the other hand, individuals with schizophrenia have repeatedly reported experiencing levels of pleasant emotions that are similar to nonpatients in laboratory studies using emotionally evocative stimuli (e.g., film clips, flavored drinks; see Kring, 1999, for a review). These findings suggest that individuals with schizophrenia may in fact be capable of experiencing a normal range and intensity of pleasant emotions in response to evocative stimuli but for some reason report experiencing little pleasure more generally.

One possible explanation for the apparent discrepancy between trait and state assessments of pleasurable experiences is that trait anhedonia reported by schizophrenia patients reflects faulty memory for subjectively experienced pleasant emotions. Specifically, deficits in the encoding and/or retention of emotional information might lead patients to recall pleasurable experiences as less pleasurable than they actually were experienced "in the moment." Items such as "I attach very little importance to having close friends" and "the beauty of sunsets is greatly overrated" from commonly used social and physical anhedonia scales (Chapman & Chapman, 1978; Eckblad, Chapman, Chapman, & Mishlove, 1982) require one to reflect on specific occurrences in his or her life and provide aggregate ratings of the frequency and intensity of emotional experiences. In light of the declarative memory deficits that characterize schizophrenia (Aleman, Higman, deHaan, & Kahn, 1999; Heinrichs & Zakzanis, 1998), it is reasonable to speculate that trait anhedonia might be associated with a basic deficit in the ability to recall pleasant emotional experiences.

The integrity of emotional memory in schizophrenia has received very limited attention. There is some evidence that schizophrenia patients demonstrate an "anhedonic" bias in their recall of emotionally valenced words. In contrast to the superior recall for positive versus negative words typically found in nonclinical samples (i.e., the "Pollyanna effect"), patients have been found to demonstrate worse recall for positive than negative words (Calev & Edelist, 1993; Koh, Grinker, Marussarz, & Forman, 1981). Although patients might be expected to demonstrate similar im-

William P. Horan and Keith H. Nuechterlein, Aftercare Research Program, Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles; Michael F. Green, Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, and Veterans Affairs Greater Los Angeles Healthcare System; Ann M. Kring, Department of Psychology, University of California, Berkeley.

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Correspondence concerning this article should be addressed to William P. Horan, UCLA Aftercare Research Program, 300 UCLA Medical Plaza, Suite 2255, Los Angeles, CA 90095-6968. E-mail: horan@ucla.edu

pairments in recalling the valence and intensity of their own emotional experiences, this issue has not yet been investigated. Such a deficit could have considerable functional consequences; one would expect patients to be less likely to seek out putatively pleasurable activities and more prone to inactivity or withdrawal if they are unable to recall such experiences as rewarding.

Recall for one's own past emotions tends to be fairly accurate in nonclinical samples, although several factors appear to affect the reconstruction of emotional memories (Christianson & Safer, 1996; Levine & Safer, 2002). For example, recall for past emotions appears to be influenced by emotional state at the time of encoding and retrieval and by subsequent appraisals (Levine & Safer, 2002). Individual differences in certain personality traits are also systematically related to recall for past emotions. Individuals low in Extraversion or trait positive affectivity have been found to underestimate in recalling the intensity of their recorded daily positive emotions, whereas individuals high in negative affect or Neuroticism overestimate in recalling the intensity of their recorded negative emotions and underestimate in recalling positive emotions (Cutler, Larsen, & Bunce, 1996; Feldman-Barrett, 1997; Safer & Keuler, 2002; Safer, Levine, & Drapalski, 2002). In light of the low Extraversion–positive affectivity and high Neuroticism–negative affectivity that characterize schizophrenia (Blanchard et al., 2001; Horan & Blanchard, 2003), similar underestimates in recall for pleasant emotions might also be expected in this disorder.

The primary goal of this study was to determine whether schizophrenia patients demonstrate a selective encoding and/or recall deficit for pleasant emotional experiences. This was accomplished by exposing patients and control participants to a variety of pleasant and neutral stimuli, obtaining reports of their immediate emotional experiences and subsequently assessing recall for their recorded emotions. It was predicted that patients and control participants would report similar levels of pleasant and high activation emotions during exposure to the stimuli. Unpleasant emotional responses were also assessed, as patients have been found to report elevated unpleasant emotion in response to pleasant stimuli (e.g., Earnst & Kring, 1999; Kring, Kerr, Smith, & Neale, 1993; Kring & Neale, 1996).

A secondary goal was to examine relationships among various measures of hedonic experience in schizophrenia, including trait physical and social anhedonia, immediate emotional responses to different types of pleasant stimuli (foods and film clips), and clinically rated anhedonia. The few studies examining relationships among these measures have typically included only two or three indices, used different methods to assess emotional responses to stimuli, and differed in patient characteristics (e.g., Berenbaum & Oltmanns, 1992; Blanchard, Bellack, & Mueser, 1994; Herbener & Harrow, 2002; Katsanis, Iacono, Beiser, & Lizabeth, 1992). By incorporating multiple measures of hedonic experience within a single outpatient sample, we sought to clarify the convergent validity of different anhedonia measures.

Participants also completed a self-report measure of behavioral inhibition system and behavioral activation system sensitivity (the Behavioral Inhibition Scale [BIS] and the Behavioral Activation Scale [BAS]; Carver & White, 1994) to address an alternative hypothesis to the faulty memory explanation of trait anhedonia. Neurobehavioral models of hedonic experience distinguish between appetitive (i.e., pleasure derived from anticipating that an activity will be enjoyable) and consummatory pleasure (i.e., pleasure derived from engaging in an enjoyable activity; Depue & Iacono, 1989; Gray, 1987; Klein, 1984). Building on this work, Kring and colleagues (Germans & Kring, 2000; Kring, 1999) proposed that schizophrenia may be characterized by intact consummatory pleasure but impaired appetitive pleasure. The BAS indexes the experience of positive emotions in response to cues of forthcoming reward (Gray, 1990) and engagement in approach behavior (Coan & Allen, 2003; Davidson, 1998). Low behavioral activation system sensitivity would thus be consistent with an appetitive pleasure deficit. We sought to determine whether self-reported behavioral activation system sensitivity is related to the various measures of hedonic experience described above in schizophrenia.

Method

Participants

Thirty schizophrenia outpatients and 31 nonpatient control participants participated. Patients met criteria for schizophrenia on the basis of the Structured Clinical Interview for *DSM–IV* (SCID; First, Gibbon, Spitzer, & Williams, 1996). Diagnostic interviewers were trained to a minimum κ of .75 for rating psychotic and mood symptoms by the Treatment Unit of the Veterans Integrated Service Network 22, Mental Illness Research, Education, and Clinical Center (Los Angeles, for which Michael F. Green is the primary investigator). All patients were receiving antipsychotic medications at clinically determined dosages ($n = 25$ for atypical; $n = 5$ for conventional). Nonpatient control participants were recruited through newspaper advertisements and flyers posted in the local community. Control participants were screened with the SCID and SCID–II (First, Gibbon, Spitzer, Williams, & Benjamin, 1996) and were excluded if they met criteria for any psychotic disorder; bipolar mood disorder; recurrent depression; substance dependence; or paranoid, schizotypal, or schizoid personality disorder. Control participants were also excluded if there was any evidence (according to participant report) of a history of psychotic disorder among their first-degree relatives. Additional exclusion criteria for all patients and control participants included age less than 18 or over 55 years, active substance use disorder in the past 6 months, identifiable neurological disorder, mental retardation, or seizure disorder.

As shown in Table 1, the groups did not significantly differ on education, sex, or the proportion of cigarette smokers. Although the percentage of participants who had ever been married was somewhat lower in the control group than in the schizophrenia group, the groups did not significantly differ in lifetime marital status. The patients were significantly older than control participants, and the proportion of Caucasian participants was higher in the control group than in the patient group. The patient group had mild to moderate levels of symptoms. Mean ratings on the five Brief Psychiatric Rating Scale (BPRS; Lukoff, Nuechterlein, & Ventura, 1986) subscales (based on the mean of the items that make up each subscale), which are described below, were as follows: Anergia, 1.9 ($SD = 0.8$); Anxiety–Depression, 2.3 ($SD = 1.0$); Thought Disturbance, 2.7 ($SD = 1.7$); Activation, 1.4 ($SD = 0.67$); and Hostile Suspiciousness, 2.1 ($SD = 0.9$). The mean rating for the BPRS total score (based on the sum of the 24 BPRS items) was 47.7 ($SD = 14.5$). Mean ratings on the Scale for Assessment of Negative Symptoms (SANS; Andreasen, 1983) subscales were as follows: Affective Flattening, 1.9 ($SD = 1.3$); Alogia, 0.7 ($SD = 1.0$); Avolition–Apathy, 2.7 ($SD = 1.0$); and Anhedonia–Asociality, 2.7 ($SD = 1.3$). Patients had a mean duration of illness of 17.8 years ($SD = 8.2$).

Emotional Experience and Recall Procedure

The procedure involved two sessions that were separated by approximately 4 hr ($M = 226.1$ min, $SD = 26.6$). During the intersession interval,

Table 1
Demographic Characteristics for Schizophrenia (n = 30) and Control (n = 31) Groups

Characteristic	Schizophrenia	Control	Statistic
Age at study entry			t (59) = 2.53*
M	46.2	40.5	
SD	9.7	7.8	
Sex			$\chi^2(1, N = 61) = 1.99$
Male (%)	83	68	
Female (%)	17	32	
Ethnicity			χ^2 (1, $N = 61$) = 5.94
Caucasian (%)	34	61	
African American (%)	43	33	
Other (%)	23	6	
Education (years)			$t(59) = -1.18$
M	12.9	13.3	
SD	1.6	0.9	
Marital status			$\chi^2(1, N = 61) = 2.40$
Never married (%)	45	61	
Currently married (%)	10	13	
Ever married (%)	45	26	
Cigarette smoking status (% smoker)	48	35	χ^2 (1, $N = 61$) = 0.40

* $p < .05$.

participants completed other neurocognitive and psychophysiological tasks (e.g., early visual processing tasks) that were part of the larger research program but not related to the current procedures. At the beginning of Session 1, a baseline measure of emotion was obtained by asking participants to complete a brief questionnaire about their current emotional state. The same questionnaire was used to collect reports of emotional experience throughout the procedures. Participants were screened for dietary restrictions and allergies and asked about their cigarette smoking status. Using a standardized script, the experimenter informed participants that the purpose of the study was to learn about the characteristics of different kinds of foods and films that affect how people respond to them, that they would be sampling a variety of foods and watching several film clips, and that they would be completing questionnaires about these experiences. We decided not to include unpleasant evocative stimuli in the study design because of our primary interest in the encoding and retention of information about pleasurable experiences and concerns that the experience of unpleasant emotions might contaminate responses to the pleasant or neutral stimuli.

Six foods (three pleasant, three neutral) and six film clips (three pleasant, three neutral) were presented in two different orders. On the basis of pilot testing of a number of different foods, we used a chocolate cookie, a brownie, and ice cream (choice of vanilla, chocolate, or strawberry) for the pleasant stimuli and plain white bread, a tortilla, and matzo bread for the neutral stimuli. Participants were given 1 min to sample each food and were told that they were free to eat as much of the sample as they wished. After 1 min, participants provided ratings of their emotional experience while sampling the food and then drank water to cleanse the palette. Participants were asked if they "strongly disliked" any of the food samples. The following numbers of participants indicated that they strongly disliked one of the foods: cookie, 2 patients; brownie, 2 patients; matzo, 2 patients and 1 control participant; bread, 1 patient and 2 control participants; and tortilla, 1 patient and 1 control participant. Emotion ratings for these strongly disliked stimuli were excluded from analyses of participants' mean emotional experience ratings for pleasant and for neutral foods.

Three film clips (3–4 min) found to elicit pleasant emotions in previous studies of schizophrenia were used, including scenes from *Stripes*, *The Money Pit*, and *Big* (Blanchard et al., 1994; Kring & Neale, 1996; Kring et al., 1993). Three neutral scenes depicted waves rolling into the shore, trains rolling on a track, and mountain scenery. After each film clip, participants rated their emotional experience while viewing the clip. The following numbers of participants reported that they had previously seen the pleasant films: *The Money Pit*, 4 patients and 19 control participants; *Stripes*, 5 patients and 12 control participants; and *Big*, 10 patients and 17 control participants.

To ensure that participants attended to the stimuli, we administered a 24-item (12 targets, 12 distracters) categorical discrimination task at the end of Session 1. A list of foods and brief descriptions of scenes were read aloud. After each item, participants responded "yes" if the item described one of the food or film stimuli or "no" if the item did not describe one of the stimuli. To enhance the ecological validity of the procedure, we did not inform participants that recall would subsequently be assessed.

At the beginning of Session 2, participants completed another baseline measure of their current emotional state. Next, participants completed the same 24-item discrimination task presented at the end of Session 1 to ensure that they were able to recall the stimuli to which they were originally exposed. Finally, participants were asked to recall how they felt while they were sampling each of the foods and viewing each of the film clips during Session 1 and to complete the same questionnaire for each stimulus on the basis of their recollections.

Clinical Ratings

BPRS. Psychiatric symptoms during the previous 2 weeks were rated with the expanded 24-item University of California, Los Angeles, version of the BPRS (Lukoff et al., 1986; Overall & Gorham, 1962) by a trained rater. Each item is rated on a scale ranging from 1 to 7. BPRS raters achieved a median intraclass correlation coefficient of .80 or higher across all items compared with the criterion ratings (Ventura, Green, Shaner, & Liberman, 1993). From this version of the BPRS, five subscale scores (based on the mean of items from the subscales; Guy, 1976) and a 24-item total score are derived.

SANS. Negative symptoms during the preceding month were evaluated using the SANS (Andreasen, 1982). Four SANS global scales were used in the current study: Anhedonia–Asociality, Alogia, Blunted Affect, and Avolition–Apathy. The SANS Attention scale was not included in the current analyses given findings suggesting that this scale is not conceptually related to the negative symptom complex (e.g., Earnst & Kring, 1997).

Questionnaires

Emotional Experience Scale. Reports of emotional experience were based on a questionnaire that was composed of selected items from the circumplex model of emotion explicated by Larsen and Diener (1992). The

scale was designed to provide a quick, reliable, and valid measurement of the valence (pleasant, unpleasant) and activation (high, low) dimensions of emotional experience. Each item was a one-word descriptor from each of the following four octants of the affective circumplex: pleasant (*cheerful*, *happy*, *pleased*), unpleasant (*sad*, *miserable*, *unhappy*), high activation (*surprised*, *activated*, *stimulated*), and low activation (*quiet*, *tranquil*, *inactive*). Participants rated each of the items on a 5-point scale (1 = *very slightly or not at all*, 2 = *a little*, 3 = *moderately*, 4 = *quite a bit*, or 5 = *extremely*). Internal consistency reliabilities (coefficient alpha) for the Pleasant, Unpleasant, High Activation, and Low Activation subscales across all stimuli were .93, .85, .79, and .51 for patients, respectively, and .93, .83, .81, and .31 for control participants, respectively. The Low Activation subscale was excluded from data analyses because of low internal consistency, which likely reflected a limited range of scores elicited by the pleasant and neutral laboratory stimuli. Participants completed the same Emotional Experience Scale at the beginning of each session (baseline), following stimulus presentation, and after the 4-hr delay.

Trait anhedonia. All participants completed the Revised Social Anhedonia Scale (RSAS; Eckblad et al., 1982) and the Physical Anhedonia Scale (PAS; Chapman & Chapman, 1978; Eckblad et al., 1982). The RSAS is a 40-item true–false self-report questionnaire intended to measure decreased pleasure derived from interpersonal sources. The 61-item true–false PAS taps a range of purportedly pleasurable experiences involving eating, touching, feeling, sex, movement, smell, and sound. These scales demonstrate good psychometric properties and have been extensively used in schizophrenia (Edell, 1995). For the RSAS, coefficient alphas were .90 for patients and .84 for control participants. For the PAS, coefficient alphas were .80 for patients and .84 for control participants.

BIS/BAS. All participants completed the BIS/BAS (Carver & White, 1994), a 20-item instrument that assesses dispositional sensitivity of the avoidance motivational system and the approach motivational system (i.e., degree of appetitive pleasure). Participants rate each item on a 1 (*strongly agree*) to 4 (*strongly disagree*) scale. A sample item from the BIS is "I worry about making mistakes." Sample items from the BAS include "I crave excitement and new sensations," "I go out of my way to get the things I want," and "When I seen an opportunity for something I like, I get excited right away." The BAS is composed of three subscales reflecting aspects of incentive responsiveness: Drive, Fun Seeking, and Reward Responsiveness. Items on each scale are summed. The scale has excellent psychometric properties (Carver & White, 1994). In the current sample, internal consistencies for the BIS were .73 for patients and .69 for control participants, and for the BAS they were .79 for patients and .82 for control participants.

Data Analysis

A three-stage data analytic approach was followed. First, preliminary analyses were done to examine potential confounding factors in the emotional experience and recall procedure. The effects of smoking status for foods and of prior viewing for films were evaluated with 2 (group) × 2 (potential confound) × 2 (stimulus valence: neutral, pleasant) multivariate analyses of variance with the three emotion ratings (pleasant, high activation, unpleasant) as dependent variables. Performance on the discrimination task at the end of Session 1 and the beginning of Session 2 was examined with a 2 (group) × 2 (time: baseline, delay) repeated measures analysis of variance (ANOVA) to ensure participants attended to the task. Baseline scores on the Emotional Experience Scale at the beginning of Sessions 1 and 2 were examined with 2 (group) × 2 (time) repeated measures ANOVAs separately for pleasant, high activation, and unpleasant emotions.

Second, performance on the emotional experience and recall procedure was evaluated. The data were analyzed with a series of 2 (group) × 2 (stimulus valence: pleasant, neutral) × 2 (stimulus type: food, film) × 2 (time) repeated measures ANOVAs with pleasant, high activation, and unpleasant emotions from the Emotional Experience Scale as dependent variables. Standardized effect sizes (*d*s; Cohen, 1988) of between-groups differences were also evaluated for each type of stimulus (presented as the mean of the effect sizes across Sessions 1 and 2).

Third, correlational analyses examined associations among the different measures of hedonic experience separately within each group. Analyses involving unpleasant emotions from the Emotional Experience Scale used square root transformed data or Spearman rank–order correlations because of skewed distributions.

Results

Preliminary Analyses

Preliminary analyses revealed no significant main effects or interactions involving group for smoking status or for prior film viewing status (there were also no significant Group × Film Viewing Status effects for any of the individual films). Given the somewhat higher prevalence of Caucasian participants among control participants, we also examined whether ethnicity (dichotomously defined as Caucasian vs. non-Caucasian) might account for group differences in emotional experience. There were no significant Group × Ethnicity interactions for any type of reported emotional experience during Session 1. For discrimination task performance, the main effects of group and time as well as their interaction were not significant. All control participants obtained perfect scores on both discrimination tasks, 29 patients obtained perfect scores at the end of Session 1 (1 patient had one false negative), and 28 patients obtained perfect scores at the beginning of Session 2 (1 patient had a false negative, and 1 patient had a false positive), suggesting that participants were adequately attentive.

Participants' baseline scores on the Emotional Experience Scale at the beginning of Sessions 1 and 2 are presented in Table 2. There were no significant main effects or interactions for pleasant or high activation emotions. For unpleasant emotions, there were significant main effects for group, $F(1, 59) = 7.75$, $p < .01$, and time, $F(1, 59) = 17.01$, $p < .001$, and a significant Group × Time interaction, $F(1, 59) = 4.12$, $p < .05$. Patients reported higher unpleasant emotions than did control participants at the beginning of Session 1, whereas the groups did not significantly differ at Session 2 ($p = .06$). To determine whether baseline emotions in Session 1 were associated with clinical symptoms, we computed correlations with the BPRS subscales. There was only one significant correlation, indicating a marginally significant association between higher unpleasant emotions and higher BPRS Anxiety–Depression ratings, $r(30) = .35$, $p = .05$. Finally, in light of group difference in age, correlations were computed between age and each of the dependent variables within each group. None of these correlations were statistically significant, and age was therefore not included in the primary analyses.

Emotional Experience and Recall Task

Pleasant emotions. Results are presented graphically in Figure 1. The group main effect was not significant, $F(1, 59) = 2.62$, $p > .05$, and there were no significant interactions involving group. Across groups, there was a significant main effect for stimulus valence, $F(1, 59) = 112.65$, $p < .001$, indicating that participants

Table 2
Group Differences on Self-Report Measures

Measure	Schizophrenia		Control			
	M	*SD*	*M*	*SD*	*t* (59)	*d*
Emotional Experience Scale at Session 1						
Baseline pleasant emotions	8.5	2.5	9.3	2.2	1.43	−0.36
Baseline high activation emotions	7.1	1.9	7.7	2.8	0.89	0.23
Baseline unpleasant emotions	4.6	2.0	3.5	1.1	2.77**	−0.67
Emotional Experience Scale at Session 2						
Baseline pleasant emotions	8.8	3.6	9.0	2.4	0.23	−0.06
Baseline high activation emotions	7.2	2.7	7.1	2.5	0.26	0.06
Baseline unpleasant emotions	3.4	0.7	3.1	0.3	1.96	0.50
Physical Anhedonia Scale	19.3	7.5	10.3	6.5	4.88**	1.06
Revised Social Anhedonia Scale	17.5	8.7	9.3	6.3	4.00**	1.00
Behavioral Inhibition Scale total	20.3	5.2	17.0	3.7	−2.76*	0.71
Behavioral Activation Scale total	38.5	7.5	40.2	7.0	0.85	−0.23
Behavioral Activation Scale Drive	10.9	3.3	10.9	3.7	−0.01	0.0
Behavioral Activation Scale Fun Seeking	11.1	2.9	12.2	2.5	1.48	−0.40
Behavioral Activation Scale Reward Responsiveness	16.6	3.2	17.2	2.1	0.85	−0.23

Note. All means are based on raw scores. d = standardized effect size.
* $p < .05$. ** $p < .01$.

reported higher levels of pleasant emotions during exposure to pleasant stimuli than to neutral stimuli, thereby providing a manipulation check. The main effects of stimulus type and of time were not significant, but there was a significant three-way interaction of Stimulus Type × Stimulus Valence × Time, $F(1, 59) = 6.82$, $p < .05$. For films, participants reported higher pleasant emotions during pleasant films in Session 1 than in Session 2, whereas participants reported higher pleasant emotions during neutral films in Session 2 than in Session 1. For foods, reports of pleasant emotions while sampling pleasant and neutral stimuli did not significantly differ across sessions. Between-groups effect sizes for pleasant emotions were in the small to medium range, with mean effect sizes (i.e., average d across Sessions 1 and 2) as follows: neutral foods = 0.12, neutral films = 0.49, pleasant foods = 0.32, and pleasant films = 0.37, suggesting that the magnitude of any group differences in pleasant emotions was not particularly substantial, especially in response to pleasant stimuli.

High activation emotions. Results are presented in Figure 2. The group main effect was not significant, $F(1, 59) = 0.09$, $p > .05$, and there were no significant interactions involving group. The main effects of stimulus type and time were not significant, but there were significant effects for stimulus valence, $F(1, 59) = 81.96$, $p < .001$, and for the three-way interaction of Stimulus Type × Stimulus Valence × Time, $F(1, 59) = 5.14$, $p < .05$. For films, participants reported higher levels of high activation emotions during neutral films in Session 2 than in Session 1, whereas no significant differences existed between sessions for pleasant films. For foods, participants reported higher levels of high activation emotions for pleasant foods in Session 1 than in Session 2, whereas no significant differences existed across sessions for neutral foods.[1] The magnitude of group differences for high activation emotions was minimal across stimuli, with the following mean effect sizes: neutral foods = 0.09, neutral films = 0.12, pleasant foods = 0.05, and pleasant films = 0.10.

Unpleasant emotions. There was a significant group main effect, $F(1, 59) = 7.01$, $p < .01$, but no significant interactions involving group, indicating that patients reported generally higher unpleasant emotions than control participants across Sessions 1 and 2 (see Figure 3). There was also a significant main effect for time, $F(1, 59) = 4.89$, $p < .05$, but no significant interactions involving time, indicating that participants generally reported higher levels of unpleasant emotions during Session 1 than Session 2. Finally, there was a significant main effect for stimulus valence, $F(1, 59) = 22.67$, $p < .001$, and the Stimulus Valence × Stimulus Type interaction was also significant, $F(1, 59) = 5.73$, $p < .05$. Participants reported higher levels of unpleasant emotions during neutral foods and films than during pleasant foods and films, and there was a nonsignificant trend for higher levels of unpleasant emotions during pleasant films than pleasant foods ($p = .08$). The magnitude of the between-groups differences was in the medium to large range: neutral foods = .37, neutral films = .49, pleasant foods = .57, and pleasant films = .56.

To determine whether the group effect remained significant after accounting for baseline unpleasant emotions, we reran these analyses including baseline unpleasant emotions in Session 1 as a covariate. The main effect of group was no longer significant, $F(1, 59) = 2.90$, $p = .10$, but the Stimulus Valence × Stimulus Type interaction remained significant ($p < .05$). Thus, the patients' higher levels of unpleasant emotions at baseline in Session 1 accounted for most of these effects.

[1] To determine whether deficits in the immediate experience or delayed recall of pleasant or high activation emotions might be characteristic of only a subgroup of highly anhedonic patients, we reran these analyses comparing patients with high versus low anhedonia. Patients were categorized on the basis of each trait anhedonia scale and on clinical ratings on the SANS, with cutoff scores derived from previous research. There were no significant group main effects or interactions for pleasant emotions during exposure to the pleasant stimuli, suggesting intact emotional experience and recall among even highly anhedonic patients.

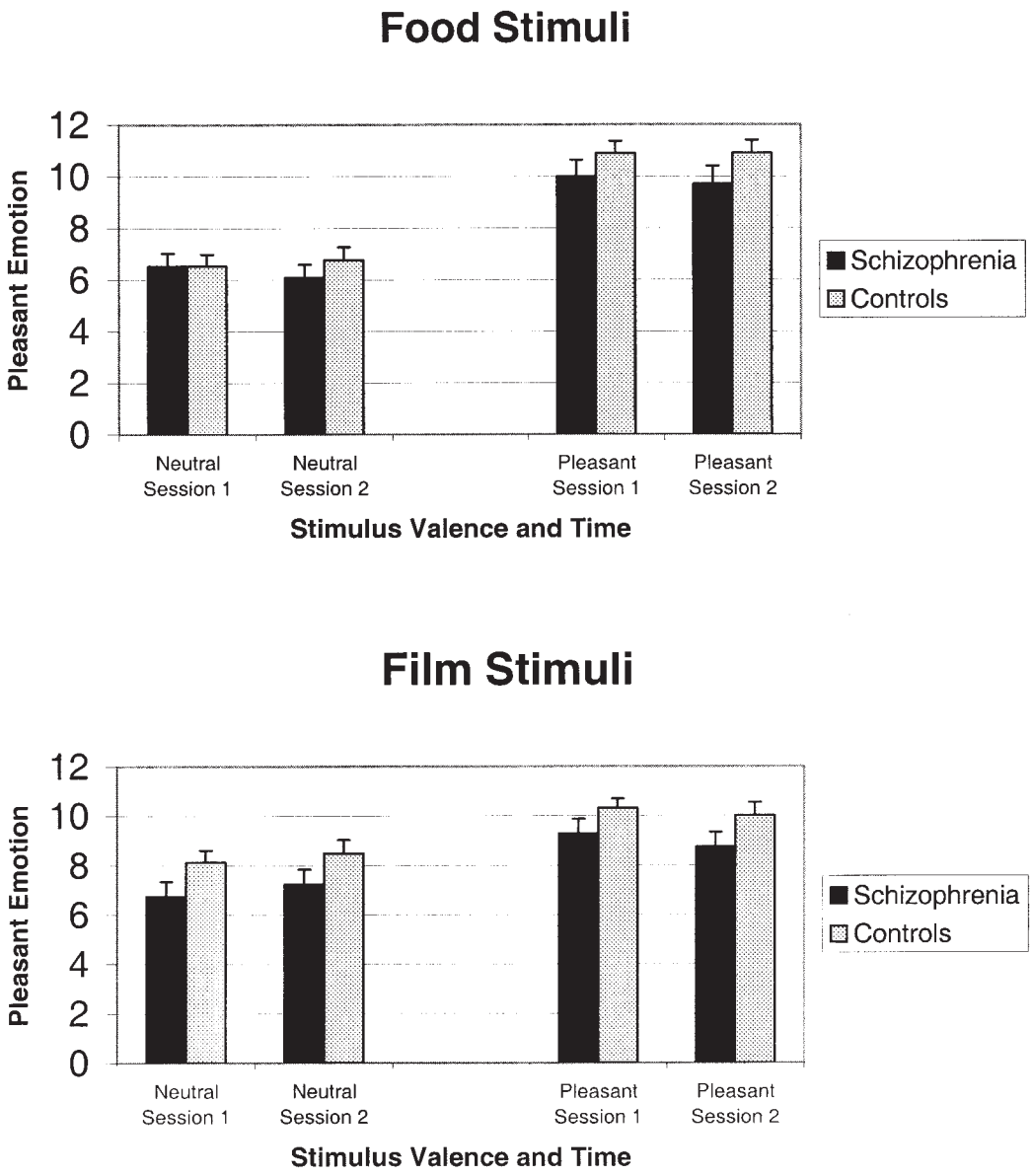

Figure 1. Mean (+ *SE*) Emotional Experience Scale ratings of pleasant emotions in the schizophrenia and control groups during the emotional experience and recall task for food and film stimuli.

Supplemental Analyses

As a cross-check on the analyses, group differences in the emotion recall procedure were also evaluated by conducting separate repeated measures ANOVAs with standardized residual change scores from Session 1 to Session 2 for the pleasant, high activation, and unpleasant emotions. These analyses revealed no significant main effects or interactions involving group for any type of emotion.

To examine intraindividual consistency of scores on the Emotional Experience Scale, we computed Pearson correlations between Sessions 1 and 2 within each group. For patients, the mean correlations across the different types of stimuli were as follows: pleasant emotions, .89; unpleasant emotions, .77; and high activation emotions, .77. For control participants, the mean correlations were as follows: pleasant, .88; unpleasant,.79; and high activation, .86. Thus, participants were highly consistent in their reports of emotional experience across sessions.

Correlates of Emotional Experience During Sessions 1 and 2

Descriptive data and results of between-groups comparisons on the self-report anhedonia and motivation measures are presented in Table 2. Patients reported higher trait social and physical anhedonia than did control participants, and the magnitude of these differences was large. In addition, patients had higher scores than did control participants on the BIS, although the

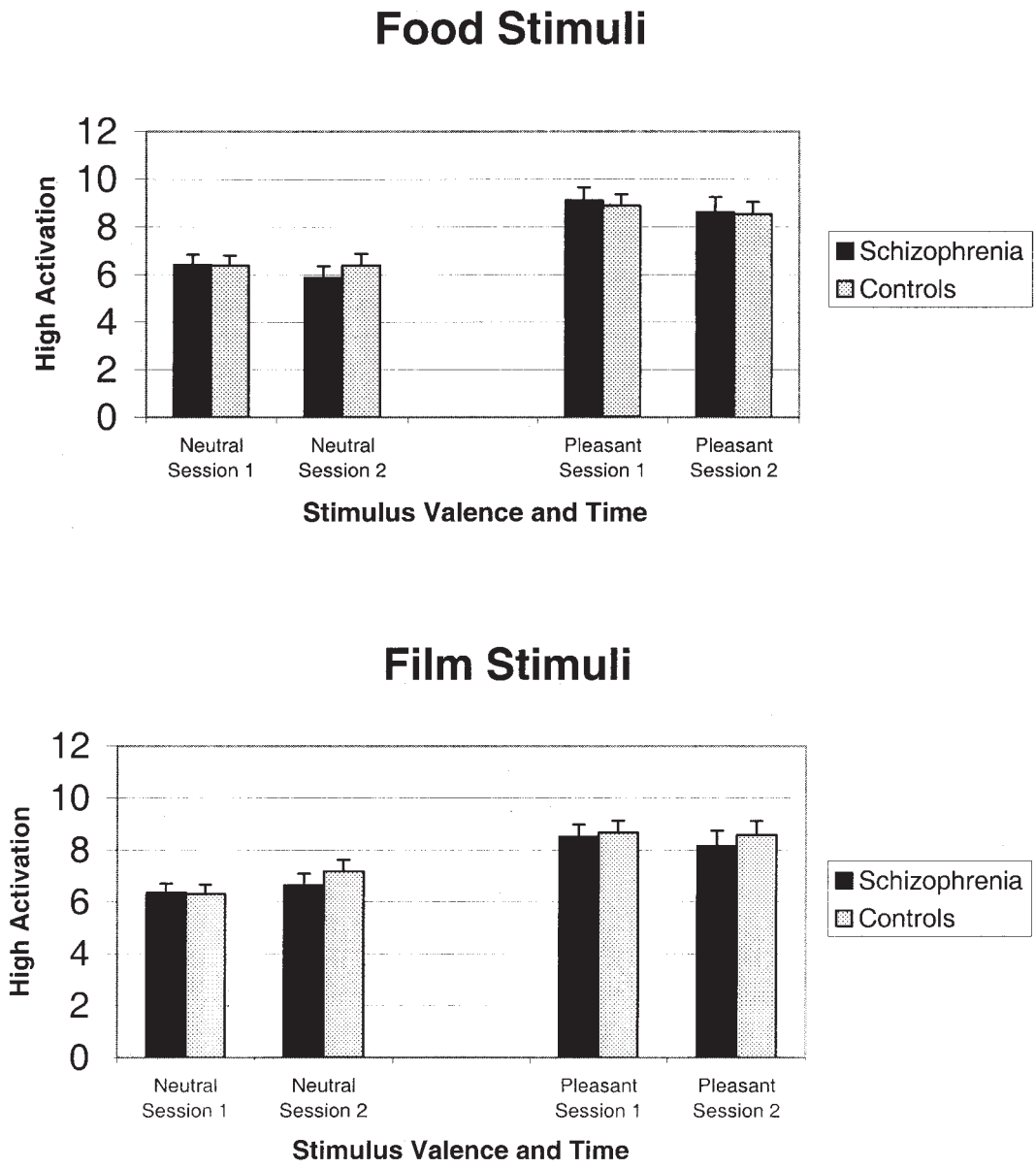

Figure 2. Mean (+ *SE*) Emotional Experience Scale ratings of high activation emotion in the schizophrenia and control groups during the emotional experience and recall task for food and film stimuli.

groups did not significantly differ on the BAS or on any of the BAS subscales.

We next evaluated whether these self-report measures as well as clinically rated anhedonia and other negative symptoms (for patients) were related to participants' reported emotional experience during Sessions 1 and 2 for each type of emotion separately within each group. Results for patients are presented in Tables 3–5. As shown in Table 3, among patients, trait anhedonia measures were not strongly related to pleasant emotions reported during Session 1 or 2. Although there were some small to medium correlations between the anhedonia scales and pleasant emotions reported for neutral films during Sessions 1 and 2, there were no substantial relationships with emotional responses to the pleasant stimuli. Most of the BIS/BAS subscales were also not strongly related to pleasant emotions. However, the BAS Reward Responsiveness subscale did demonstrate several substantial correlations. BAS Reward Responsiveness strongly and significantly correlated with pleasant emotions for pleasant foods and films across both sessions. The correlations between BAS Reward Responsiveness and pleasant emotions for the neutral stimuli were somewhat smaller and fell in the medium range. Regarding the SANS subscales, the Anhedonia–Asociality subscale demonstrated medium correlations with pleasant emotions for pleasant films and foods during both sessions and was not strongly associated with responses to the neutral stimuli. Thus, measures of approach motivation and clinically rated Anhedonia–Asociality demonstrated substantial relationships with pleasant emotions elicited by evocative stimuli among the patients.

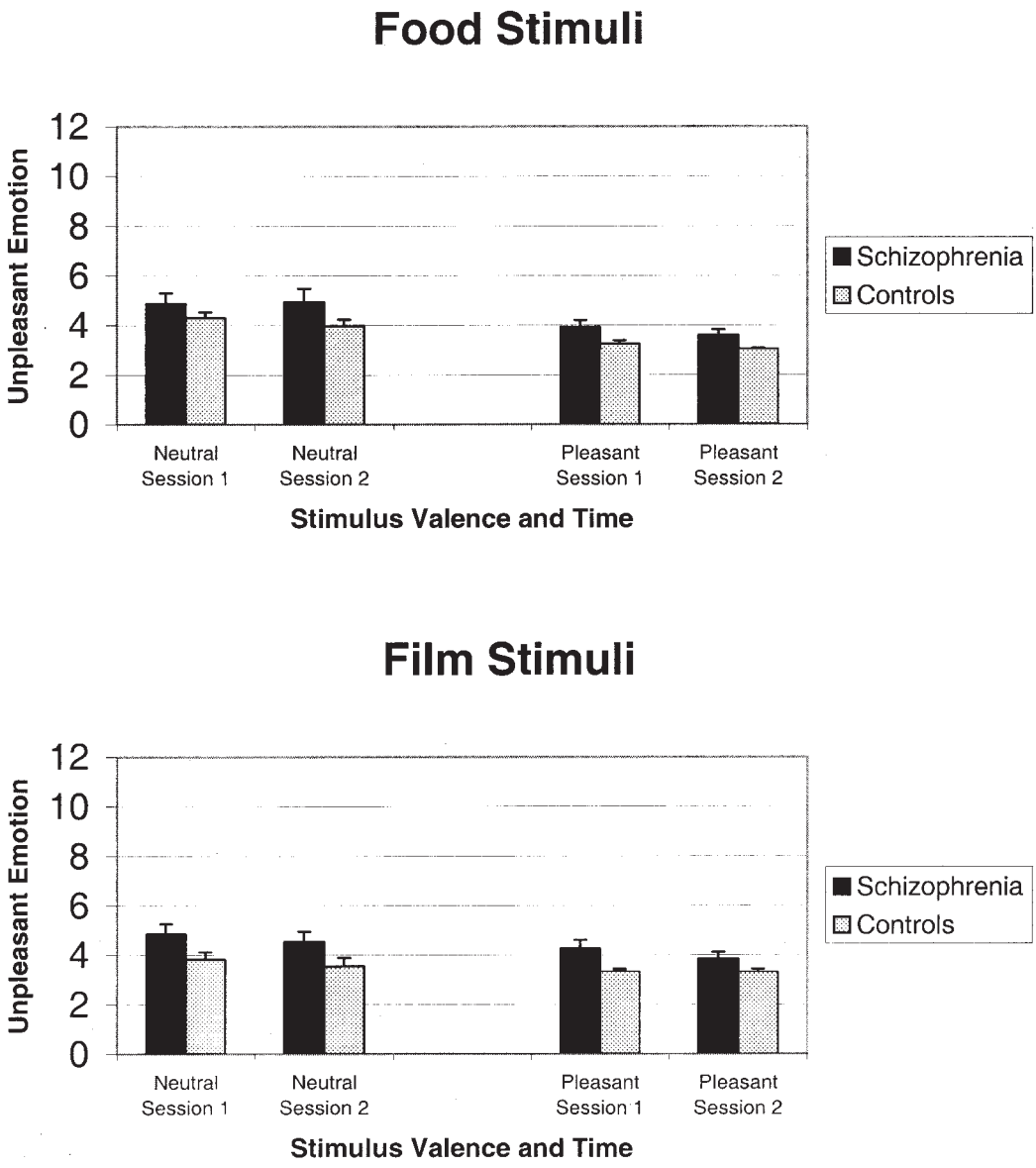

Figure 3. Mean (+ *SE*) Emotional Experience Scale ratings of unpleasant emotions in the schizophrenia and control groups during the emotional experience and recall task for food and film stimuli.

For high activation emotions (see Table 4), results for BAS Reward Responsiveness paralleled the findings for pleasant emotions. BAS Reward Responsiveness significantly and strongly correlated with high activation emotions in response to pleasant stimuli (particularly foods) across Sessions 1 and 2, whereas correlations were generally smaller for neutral stimuli. During Session 2, BAS total and BAS Drive scores also demonstrated medium, though nonsignificant, positive correlations with reports of high activation emotions to pleasant stimuli, with smaller correlations for neutral stimuli. In addition, there were medium negative correlations between physical anhedonia and responses to pleasant stimuli as well as neutral films across Sessions 1 and 2 (only a few correlations were statistically significant). Finally, during Session 2, SANS Anhedonia–Asociality negatively correlated with reported emotions for pleasant films and also demonstrated a medium negative association with pleasant foods. A measure of approach motivation was thus most strongly associated with high activation emotions in response to the pleasant evocative stimuli.

As shown in Table 5, the trait and clinical measures were generally not strongly related to reports of unpleasant emotions. Social anhedonia demonstrated some small to medium positive correlations with reported unpleasant emotions across both neutral and pleasant stimuli during Sessions 1 and 2, whereas physical anhedonia demonstrated medium negative correlations with responses to neutral foods and pleasant films during Session 1. Although reports of high activation emotions for neutral films during Session 2 significantly correlated with BAS Fun Seeking and demonstrated a medium correlation with BAS Reward Responsiveness, correlations generally fell in the small range.

Table 3
Correlations Between Trait Measures and Pleasant Emotions Reported During Sessions 1 and 2 Within the Schizophrenia Group

	Session 1				Session 2			
	Neutral		Pleasant		Neutral		Pleasant	
Measure	Foods	Films	Foods	Films	Foods	Films	Foods	Films
Revised Social Anhedonia Scale	−.21	−.35*	−.11	−.16	−.20	−.26	−.13	−.10
Physical Anhedonia Scale	.06	−.25	−.21	−.12	.03	−.30	−.24	−.17
Behavioral Inhibition Scale total	−.08	−.22	.05	.07	−.14	−.36*	.08	−.03
Behavioral Activation Scale total	−.01	.05	.23	.19	−.11	.00	.22	.24
Behavioral Activation Scale Drive	−.14	−.15	−.10	−.08	−.20	−.21	−.15	−.05
Behavioral Activation Scale Fun Seeking	−.22	−.05	.21	.14	−.27	−.06	.19	.25
Behavioral Activation Scale Reward Responsiveness	.32†	.32†	.47*	.39*	.20	.28	.50*	.40*
SANS Affective Flattening	−.43*	−.08	−.20	−.24	−.25	−.08	−.16	−.12
SANS Alogia	−.17	.02	.11	−.04	−.11	.01	.06	.07
SANS Avolition–Apathy	−.14	.11	−.11	−.20	−.01	.06	−.08	−.22
SANS Anhedonia–Asociality	−.15	−.18	−.34*	−.30	.02	−.21	−.33†	−.32†

Note. A correlation of .50 is large, .30 is medium, and .10 is small (Cohen, 1988). SANS = Scale for the Assessment of Negative Symptoms.
† $p < .10$. * $p < .05$.

Among control participants, there were no statistically significant or trend-level correlations with the physical or social anhedonia scales and reports of emotional experience of any kind. On the BIS/BAS, BAS Drive was negatively correlated with unpleasant emotions during neutral films, $r(31) = -.39$, $p < .05$. There were no additional significant or trend-level correlations.

Correlations Among Self-Report Measures and Clinical Ratings

Correlations within the patient group are presented in Table 6. Social anhedonia was significantly and positively correlated with physical anhedonia but was not significantly correlated with any

Table 4
Correlations Between Trait Measures and High Activation Emotions Reported During Sessions 1 and 2 Within the Schizophrenia Group

	Session 1				Session 2			
	Neutral		Pleasant		Neutral		Pleasant	
Measure	Foods	Films	Foods	Films	Foods	Films	Foods	Films
Revised Social Anhedonia Scale	−.25	−.10	−.13	.08	−.18	−.11	−.13	−.04
Physical Anhedonia Scale	−.17	−.31	−.29	.25	.00	−.42*	−.34*	−.29
Behavioral Inhibition Scale total	.08	−.22	.13	.01	−.15	−.53**	.04	.08
Behavioral Activation Scale total	.09	−.10	.28	.21	−.16	.00	.30	.30
Behavioral Activation Scale Drive	−.13	−.29	.06	.06	−.25	−.15	−.04	.02
Behavioral Activation Scale Fun Seeking	−.06	−.14	.13	.21	−.35*	−.07	.25	.33†
Behavioral Activation Scale Reward Responsiveness	.32†	.19	.50**	.36*	.20	.22	.55**	.40**
SANS Affective Flattening	−.26	.12	−.20	−.07	−.24	.01	−.18	.01
SANS Alogia	−.06	.06	−.02	.07	−.12	.01	−.01	.11
SANS Avolition–Apathy	−.04	.37	−.17	.15	.07	.06	−.21	−.25
SANS Anhedonia–Asociality	−.09	.04	−.25	−.22	.13	−.16	−.32†	−.36*

Note. A correlation of .50 is large, .30 is medium, and .10 is small (Cohen, 1988). SANS = Scale for the Assessment of Negative Symptoms.
† $p < .10$. * $p < .05$. ** $p < .01$.

Table 5
Correlations Between Trait Measures and Unpleasant Emotions Reported During Sessions 1 and 2 Within the Schizophrenia Group

	Session 1				Session 2			
	Neutral		Pleasant		Neutral		Pleasant	
Measure	Foods	Films	Foods	Films	Foods	Films	Foods	Films
Revised Social Anhedonia Scale	−.11	.26	.25	.09	.25	.34*	.28	.24
Physical Anhedonia Scale	−.31	−.10	−.07	−.32†	−.19	.01	−.10	−.17
Behavioral Inhibition Scale total	.08	.25	−.06	.13	.23	.35*	.05	.10
Behavioral Activation Scale total	.11	−.01	−.09	−.12	.24	.04	−.11	−.23
Behavioral Activation Scale Drive	−.19	−.21	−.15	−.23	−.17	−.20	.19	−.27
Behavioral Activation Scale Fun Seeking	.28	.07	−.01	−.06	.47*	.25	.02	−.08
Behavioral Activation Scale Reward Responsiveness	.21	.14	−.05	.01	.32†	.07	.09	−.20
SANS Affective Flattening	.17	.24	.07	.10	.25	.27	.11	.15
SANS Alogia	.17	−.06	−.23	−.27	.28	.13	−.24	−.25
SANS Avolition–Apathy	.20	.07	.14	.14	.11	−.04	.02	.15
SANS Anhedonia–Asociality	−.07	−.05	.12	−.02	−.15	−.08	.12	.13

Note. A correlation of .50 is large, .30 is medium, and .10 is small (Cohen, 1988). SANS = Scale for the Assessment of Negative Symptoms.
† $p < .10$. * $p < .05$.

other measures, although correlations with SANS Affective Flattening and Anhedonia–Asociality approached a medium level. In contrast, physical anhedonia was significantly correlated with several other measures, including higher SANS Anhedonia–Asociality and SANS Alogia scores and lower BAS scores, particularly on the BAS Fun Seeking and Reward Responsiveness subscales. In addition, BAS Reward Responsiveness negatively correlated with SANS Anhedonia–Asociality and SANS Affective Flattening, and BAS Fun Seeking negatively correlated with SANS Anhedonia–Asociality. Physical anhedonia and SANS Anhedonia–Asociality thus demonstrated substantial associations with each other and with the BAS Reward Responsiveness and Fun Seeking subscales.

Within the control group, higher physical anhedonia significantly correlated with lower total BAS, $r(31) = -.33$, $p < .05$, and with lower BAS Drive, $r(31) = -.36$, $p < .05$. There were no other significant correlations between the physical or social anhedonia scales and the BIS/BAS among control participants.

Discussion

The primary goal of this study was to determine whether trait anhedonia in schizophrenia reflects deficient encoding or retention for pleasurable experiences. Consistent with prior research, patients reported elevated trait social and physical anhedonia yet did not substantially differ from control participants in their reported

Table 6
Correlations Among Self-Report Scales and Clinical Ratings Within the Schizophrenia Group

Scale	1	2	3	4	5	6	7	8	9	10	11
1. Revised Social Anhedonia Scale	—	.35*	.26	−.08	.01	.27	−.03	−.03	−.16	.14	.05
2. Physical Anhedonia Scale		—	.22	.39*	.16	.53**	−.37*	−.39*	−.20	−.35*	−.02
3. SANS Affective Flattening			—	.48*	.42*	.43*	.16	−.46*	−.01	−.05	−.08
4. SANS Alogia				—	.29	.16	−.17	−.25	−.15	−.01	−.06
5. SANS Avolition–Apathy					—	.62**	−.16	−.09	−.13	−.17	−.33
6. SANS Anhedonia–Asociality						—	−.29	−.44*	.02	−.35*	−.31
7. Behavioral Activation Scale total							—	.79**	.74**	.87**	.26
8. Behavioral Activation Scale Reward Responsiveness								—	.38*	.64**	.37*
9. Behavioral Activation Scale Drive									—	.49**	−.07
10. Behavioral Activation Scale Fun Seeking										—	.34
11. Behavioral Inhibition Scale total											—

Note. SANS = Scale for the Assessment of Negative Symptoms.
* $p < .05$. ** $p < .01$.

experiences of pleasant and high activation emotions in response to evocative pleasant stimuli. These findings provide further support for the notion that consummatory pleasure, or pleasure derived from engagement in enjoyable experiences, is intact in schizophrenia (see Kring, 1999). There were also no significant group differences in delayed recall for recorded pleasant and high activation emotions, with both groups demonstrating high levels of intraindividual consistency in reports of emotional experience across sessions. Encoding and short-term retention for pleasurable experiences thus appear to be intact in schizophrenia, suggesting that trait anhedonia is not secondary to deficiencies in these memory processes.

Although the groups were generally similar in their reports of pleasant and high activation emotions during exposure to the evocative stimuli, the patients' emotional experiences were not wholly identical to those of the control participants. Patients reported slightly but significantly higher levels of unpleasant emotions during the recall task than did control participants, which is consistent with previous studies reporting higher levels of unpleasant emotions during exposure to both unpleasant and pleasant stimuli in schizophrenia (Earnst & Kring, 1999; Kring et al., 1993; Kring & Neale, 1996). This pattern is notable in light of the fact that unpleasant evocative stimuli were intentionally excluded from the current study design because our central interest was in the hedonic deficit of schizophrenia. The patients also reported slightly higher levels of unpleasant emotions than did control participants prior to beginning the task, and these were marginally related to clinical ratings of anxiety–depression on the BPRS. These generally heightened levels of unpleasant emotions are consistent with the elevated trait negative affectivity or Neuroticism reported in schizophrenia (Blanchard et al., 2001; Horan et al., 2005) as well as the patients' self-reports of heightened behavioral inhibition system sensitivity, which has been linked to more frequent experiences of unpleasant emotions such as fear, frustration, anxiety, and sadness in response to signals of punishment, nonreward, and novelty (Gray, 1990).

Why might the patients have reported generally higher levels of unpleasant emotions during the emotional experience and recall task? One speculative explanation is that schizophrenia may be characterized by disturbances in emotion regulation (e.g., Gross, 2002; Gross & John, 2003). Perhaps some patients are deficient in their ability to downregulate unpleasant emotions in the context of putatively enjoyable experiences. Indeed, trait negative affect in schizophrenia is related to maladaptive coping (Horan & Blanchard, 2003) as well as trait anhedonia (Blanchard et al., 2001). The experience of unpleasant emotions during otherwise pleasant experiences might undermine the adaptive benefits of pleasant emotions for cognition, social functioning, and resiliency to stress (Fredrickson, 1998; Isen, 1999; Tugade & Fredrickson, 2004) and have the unfortunate consequence of perpetuating avoidance of enjoyable activities.

Although the schizophrenia group reported elevated scores on the trait social and physical anhedonia scales, these scales generally demonstrated only moderate relationships with other measures of hedonic experience. Among patients, social anhedonia was moderately related to physical anhedonia, as has been reported in previous research (e.g., Blanchard et al., 1994, 1998; Katsanis et al., 1992), but was not significantly related to any other measure of hedonic experience. Physical anhedonia was also not significantly related to immediate emotional responses to pleasant stimuli but was associated with clinical ratings of Anhedonia–Asociality (as well as Alogia). However, physical anhedonia has previously been reported to be associated with emotional responses to evocative film clips but not with clinically rated anhedonia (Blanchard et al., 1994). These inconsistencies may reflect differences in patient characteristics and the time periods covered by the clinical assessments of anhedonia across studies. Blanchard et al. (1994) conducted SANS Anhedonia–Asociality assessments that covered the previous week in acutely ill inpatients, whereas the clinical ratings in the current study covered the previous 4 weeks among community-dwelling outpatients, which may reflect more characteristic individual differences in functioning and emotional experience. Individual differences in Anhedonia–Asociality ratings among patients also demonstrated significant (though moderate) levels of convergence with reports of pleasant emotions during exposure to pleasant stimuli across sessions, as well as certain aspects of behavioral activation system and behavioral inhibition system sensitivity in the current study. Overall, commonly used measures of self-reported trait social and physical anhedonia demonstrated only limited convergence with other measures of hedonic experience in schizophrenia, whereas somewhat higher levels of convergence were found for clinical ratings of Anhedonia–Asociality.

In contrast to the social and physical anhedonia scales, self-reported scores on the BIS/BAS demonstrated a number of significant relationships with other measures of hedonic experience. As noted above, behavioral activation system sensitivity is considered an index of appetitive pleasure. Among patients, lower BAS Reward Responsiveness scores were associated with lower levels of pleasant emotions during exposure to both foods and films and were also associated with lower reports of high activation emotions in response to several of these stimuli. Additionally, low behavioral activations system sensitivity correlated with self-reported trait physical anhedonia as well as clinically rated anhedonia–asociality and affective flattening. Disturbances in behavioral activation system sensitivity are associated with the symptoms of mood disorders (e.g., Kasch, Rottenberg, Arnow, & Gotlib, 2002; Meyer, Johnson, & Winters, 2001) and have been hypothesized on theoretical grounds to be related to negative symptoms and low levels of pleasant emotions in schizophrenia (Fowles, 1994, 2003). The current findings suggest that further investigation of low behavioral activation system sensitivity and deficient appetitive pleasure may indeed shed light on the nature of hedonic deficit in schizophrenia.

In summary, the overall pattern of results suggests that the trait anhedonia commonly reported by schizophrenia patients reflects neither a global consummatory pleasure deficit nor faulty short-term memory for pleasant emotional experiences. Instead, schizophrenia might be associated with deficient appetitive pleasure and/or pleasurable experiences that are "contaminated" by co-occurring elevations of unpleasant emotions.

Several limitations should be considered in interpreting these findings. First, the 4-hr delay interval was considerably shorter than the interval used in studies examining recall for emotional experiences in nonclinical samples (e.g., Levine & Safer, 2002). Although this delay interval is sensible for testing the hypothesis that trait anhedonia reflects the learning and memory deficits that are characteristic of schizophrenia, associated limitations include

the lack of direct correspondence to the nonclinical research literature on recall for emotional experiences and the remaining possibility that patients differ from control participants in recalling emotional experiences at longer durations. Both of these limitations can be addressed in studies using longer delay intervals that more closely match typical studies of trait congruency effects on emotional memory.

Second, participants did not complete a nonemotional explicit memory task, which could have been useful in determining whether significant individual differences in recall for emotional experiences exist among patients. Third, the generalizability of these findings to daily emotional experiences outside the laboratory is uncertain but could be evaluated with more naturalistic methods, such as the experience sampling method (e.g., Feldman-Barrett, 1997). Fourth, a limited range of evocative stimuli was examined, and consummatory pleasure may be deficient in schizophrenia for other types of laboratory stimuli (e.g., odors; Moberg et al., 2003) or in other contexts, such as affiliative social interactions (e.g., see Blanchard et al., 1998). Along these lines, as a result of our focus on anhedonia and the experience of pleasant emotions, only a narrow range of evocative stimuli was used. Future studies of emotional memory in schizophrenia might benefit from including stimuli that elicit a wider range of emotions from the affective circumplex. Fifth, it may be useful to pay greater attention to the specific films selected for use as neutral stimuli in future studies, as some of the neutral films used in the current study may elicit low arousal pleasant emotions (e.g., contentment) that were not directly assessed. Sixth, our ability to detect statistically significant group differences and correlations was limited by the size of our sample. Seventh, correlational analyses were conducted in an exploratory manner without correction for multiple statistical tests, and it will be important to determine their replicability. Eighth, the effects of antipsychotic medications on hedonic experience are not clear, although evidence suggests such effects are minimal (Kring & Earnst, 1999). Ninth, participants were predominantly male and it is not clear whether similar results would be found in a larger female sample (Salem & Kring, 1998).

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