



## Social anhedonia and affiliation: Examining behavior and subjective reactions within a social interaction

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### ABSTRACT

Social anhedonia is a promising indicator for the vulnerability towards developing schizophrenia-spectrum disorders and is an important determinant of the social impairment associated with these disorders. It is unknown if social anhedonia is associated with true deficits in experiential reactions or if lower social functioning in social anhedonia reflects behavioral deficits in social skill or initiation of social contact. Using a novel social interaction task, the current study compared controls ( $n=60$ ) to individuals elevated on social anhedonia ( $n=49$ ) on observer-rated social skill and facial affect and participant self-reports of their experiential reactions to an affiliative interaction. Compared to the control group, the social anhedonia group was rated as behaviorally less affiliative and less socially skilled during the affiliative interaction. In response to the social interaction, the social anhedonia group reported less change in positive affect, less willingness to engage in future social interactions with the interaction partner, and less positive reactions toward the interaction partner compared to controls. There were no group differences in facial displays of emotion. Using a standardized affiliative stimulus, it was demonstrated that individuals high in social anhedonia have alterations in both their social skill and in their self-reported experiential reactions during a social interaction.

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### 1. Introduction

The reduced ability to experience pleasure from social experiences, social anhedonia, is a hallmark feature of schizophrenia (Meehl, 1962), is a key negative symptom (Blanchard and Cohen, 2006; Horan et al., 2006; Blanchard et al., 2011), and contributes to social dysfunction in schizophrenia (Meehl, 1962; Blanchard et al., 1998). Given its association with schizophrenia and related spectrum disorders, social anhedonia has also been studied as a potential indicator of schizotypy and other spectrum disorders (Kwapil, 1998; Kwapil et al., 2008; Gooding et al., 2005; Blanchard et al., 2011). Focusing on social outcomes, in non-clinical individuals, social anhedonia is associated with poorer social adjustment (Mishlove and Chapman, 1985; Kwapil, 1998; Diaz et al., 2002; Blanchard et al., 2011), less social support (Blanchard and Brown, 1999; Blanchard et al., 2011), and problematic family relations (Blanchard et al., 2011).

Despite evidence of impairment on broad indicators of social functioning described above, less is known about the actual social behavior of individuals with elevated social anhedonia. Recent experience-sampling methodology (ESM) studies have attempted

to examine social dysfunction in the daily lives of people with social anhedonia and have found that these individuals interact with others less frequently (Brown et al., 2007; Kwapil et al., 2008), report a preference for solitude and are alone by choice (Brown et al., 2007; Kwapil et al., 2008), and when in social situations, they take part in larger and less intimate groups and do not feel social (Kwapil et al., 2009). Although these findings are highly informative and tell us a great deal about the social worlds of individuals high in social anhedonia, there are a number of questions that remain. The ESM studies are based on self-reports of social activity and subjective responses to the environments that these individuals encounter. Thus, it is unclear if lower positive affect reported by individuals high in social anhedonia (e.g., Brown et al., 2007) reflects a lack of capacity for pleasure or if these altered emotional experiences reflect different social environments encountered by these individuals. Individuals high in social anhedonia may self-select less reinforcing social environments that lead to subjective declines in positive affect. Alternatively, schizoid and schizotypal characteristics may be associated with behaviors that elicit peer rejection as reflected by findings that these traits are associated with peer ratings of less likeability (Oltmanns et al., 2004). Additionally, the ESM findings leave open the question of how social anhedonia is manifested in social behavior and how this may contribute to difficulties in social interactions.

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The goal of the present study was to conduct direct assessments of social behavior of individuals high in social anhedonia to examine the potential underpinnings and mechanisms of social anhedonia. Maladaptive social behavior (i.e., poor social skill) may be a part of the process that leads to the manifestation of individual differences in the experience of pleasure that then invokes non-rewarding social environments. For this purpose we developed a novel video task that permitted us to standardize the social partner across participants while eliciting social behavior and collecting self-reports of emotional and affiliative responding.

In the realm of social behavior we examined behavioral ratings of social skill and facial emotional expression. Successful social interactions are based on both verbal and nonverbal social skills (Hersen and Bellack, 1976; Bellack et al., 2004). Most studies assessing social skill in clinical populations focus on using role-plays that are not based on social or interpersonal contexts that accurately examine the social pleasure deficits that underlie social anhedonia (e.g., in role-plays people have to solve conflicts, such as pleading to keep their job) (e.g., Bellack et al., 1990; Pinkham et al., 2007). Interestingly, there has yet to be an examination of whether non-clinical individuals high in social anhedonia manifest behavioral skills deficits in response to a laboratory paradigm. Social skill deficits might suggest factors that contribute to the social difficulties evident in individuals high in social anhedonia.

Beyond broad skills, an important feature of behavior that is relevant to social communication is the facial display of emotion (see review by Krings and Moran, 2008). Diminished emotional expression may have a negative impact on social relations (Butler et al., 2003). Thus, reduced facial emotional expression may have important implications for social functioning. Importantly, research suggests that social anhedonia may be associated with diminished emotional expression. Within non-clinical samples, social anhedonia has been correlated with self-reports of diminished emotional expression (Krings et al., 1994a). In the context of a clinical interview, behavioral codings of expressivity have shown that compared to controls, individuals high in social anhedonia exhibit diminished displays of affect (Collins et al., 2005). Extending this finding, Leung et al. (2010) demonstrated that individuals high in social anhedonia were less facially expressive than controls both on a self-report measure of expressivity and in behavioral ratings of facial expressivity in response to film clips. Emotional expression in an affiliative interaction has not yet been examined to determine if the above results may generalize to more naturalistic social behavior.

Although the social behaviors described above may contribute to the social dysfunction experienced by people elevated on social anhedonia, understanding the subjective emotional experience of these individuals in response to social events may clarify whether social dysfunction is also driven by an inherent diminished experience of pleasure from social events. The diminished ability to experience pleasure from social relationships is considered as the defining characteristic of social anhedonia (Meehl, 1962). Several studies have now shown that social anhedonia in non-clinical individuals is characterized by decreased positive affect (Gooding et al., 2002; Kerns et al., 2008; Leung et al., 2010; Blanchard et al., 2011). However, previous studies have not examined subjective responding in laboratory settings in which participants are socially engaged with an affiliative stimulus. Therefore, understanding the emotional responsivity of these individuals during a social encounter could shed light on whether social dysfunction is driven by subjective responding and/or behavior deficits.

In summary, our knowledge of the social behaviors and emotional responding of people elevated on social anhedonia is limited. The purpose of the current study was to examine

whether individuals elevated on social anhedonia behave differently in social interactions compared to controls and to better understand the role of emotional experience within social situations. First, it was hypothesized that individuals with social anhedonia would report fewer social supports and poorer social functioning as compared to controls. Second, it was hypothesized that participants with social anhedonia would display less observer-rated social skill during a social affiliation interaction task compared to controls. Third, we predicted that participants with social anhedonia would be characterized by reduced emotional expression, as determined by behavioral ratings of facial expressivity, in response to the social interaction compared to controls. Finally, it was also expected that participants with social anhedonia would report experiencing less positive affect and lower affiliative reactions in response to the social interaction compared to controls.

## 2. Methods and materials

### 2.1. Participants

Participants were between the ages of 18 and 30 years who attended a large public university in Maryland. Individuals completed a screening questionnaire, the Revised Social Anhedonia Scale (RSAS; Eckblad et al., 1982) online. Individuals were excluded if they endorsed three or more items in the unexpected direction on the RSAS Infrequency Scale (Chapman and Chapman, 1976). Individuals scoring within the top 10% of RSAS scores within each gender were identified as elevated on social anhedonia. This cut-off score has been used to effectively identify people high on social anhedonia (Germine et al., 2011). Individuals with scores within 0.5 standard deviations of the mean were identified as potential control participants. The final sample included 49 people in the social anhedonia group and 60 people in the control group. As seen in Table 1, participants did not significantly differ on age ( $t(107)=1.35, p=0.181$ ), race ( $\chi^2(4)=1.59, p=0.810$ ), or gender ( $\chi^2(1)=0.843, p=0.359$ ). All participants were compensated for their participation with monetary payment or course research credit.

### 2.2. Measures

#### 2.2.1. Symptom ratings and social functioning

The Schizotypal Personality Questionnaire (SPQ; Raine, 1991) and the Beck Depression Inventory-II (BDI-II) assessed for schizotypal personality symptoms and depressive symptoms in adults, respectively. The SPQ was administered to assess a broader range of schizotypal characteristics in our sample (e.g., do individuals in the social anhedonia group truly endorse more schizotypal traits?). The Social Adjustment Scale: Short (SAS-SR; Weissman and Bothwell, 1976) assessed social functioning. The Social Support Questionnaire (SSQ; Sarason et al., 1983, 1987) assessed the perceived number of and satisfaction with social supports.

#### 2.2.2. Social affiliation interaction task

Adapting procedures from prior laboratory studies examining mate selection and behavior (Simpson et al., 1993; Simpson et al., 1999; Gangestad et al., 2004), a video was developed to elicit affiliative social behaviors and positive emotion from participants. This video was developed to address the limitations of role-play stimuli previously used to measure social skill in clinical populations. In this simulated social affiliative interaction we created, participants were led to believe that the confederate in the video was an actual participant in another room that was interacting with them live via a closed-circuit video camera. The clip, which lasted 2 min 43 s, featured a friendly, attractive, and outgoing female who discussed her social relationships and activities enjoyed with others, such as going to parties and school sporting events. As the video clip ended, the video confederate asked participants what they like to do with friends and family, at which point the video concluded and the participants were instructed to respond. Participants were told that this was a study of how people get to know one another and they were told that the video confederate would also be watching them from the other room. Participants were recorded while they watched the confederate's introduction and while they responded to the confederate.

#### 2.2.3. Positive and negative affect schedule (PANAS)

The PANAS (Watson et al., 1988) is a 20-item self-report measure of positive and negative affect. Four additional items measuring affiliative emotions were included in this measure: *friendly*, *rejected*, *lonely*, and *sociable*. In the current study, the PANAS was used with short-term instructions, such as *right now*, to

**Table 1**

Participant demographics and descriptive statistics of self-report participant characteristics and social functioning for individuals elevated on social anhedonia and controls.

Variable	SocAnh (n=49) M (S.D.), [range]	Control (n=60) M (S.D.), [range]	F	Cohen's d
Age (in years)	19.96 (2.38), [18–30] % (n)	19.48 (1.23), [18–23] % (n)		
Gender (%)				
Female	65.3 (32)	65.7 (34)		
Race (%)				
White	61.2 (30)	63.3 (38)		
Black	20.4 (10)	15.0 (9)		
Hispanic	4.1 (2)	1.7 (1)		
Asian	10.2 (5)	13.3 (8)		
Multi-racial	4.1 (2)	6.7 (4)		
BDI-II	10.86 (7.14), [1–37]	7.95 (5.07), [0–28]	<b>6.15*</b>	0.47
SPQ			<b>6.71**</b>	
Ideas of reference	3.54 (2.53), [0–9]	3.82 (2.05), [1–9]	0.36	0.12
Social anxiety	4.98 (2.35), [0–8]	3.44 (2.37), [0–8]	<b>10.92**</b>	0.65
Odd beliefs	0.94 (1.64), [0–7]	1.20 (1.43), [0–7]	0.76	0.17
Perceptual experiences	2.35 (1.94), [0–8]	2.32 (1.88), [0–8]	0.01	0.02
Eccentric behavior	3.46 (2.38), [0–7]	2.80 (2.04), [0–7]	2.29	0.30
No friends	4.48 (2.10), [0–9]	1.63 (1.71), [0–9]	<b>56.91**</b>	1.49
Odd speech	4.58 (2.79), [0–9]	3.61 (2.08), [0–8]	<b>4.04*</b>	0.39
Constricted affect	2.79 (1.62), [0–7]	1.69 (1.59), [0–6]	<b>12.08**</b>	0.69
Suspiciousness	3.77 (2.22), [0–8]	2.67 (2.01), [0–7]	<b>6.94**</b>	0.52
SPQ total	30.90 (11.30), [5–58]	23.17 (9.97), [5–49]	<b>13.47**</b>	0.73
SAS	100.59 (8.89), [73–116]	107.21 (7.52), [88–123]	<b>17.74**</b>	0.80
SSQ				
Number	4.24 (1.76), [0.83–9]	5.29 (1.72), [0.83–9]	<b>9.98**</b>	0.68
Satisfaction	5.07 (0.74), [3–6]	5.48 (0.70), [2.67–6]	<b>8.89**</b>	0.57

Note: BDI-II, Beck Depression Inventory-II; SAS, Social Adjustment Scale; SPQ, Schizotypal Personality Questionnaire; SSQ, Social Support Questionnaire.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

evaluate emotional reactions before and after the social affiliation interaction task. Cronbach's alpha obtained in our study for PA and NA was 0.89 and 0.71, respectively.

#### 2.2.4. Willingness to interact scale (WILL)

The WILL (Coyne, 1976) is a 6-item assessment of willingness to engage in interactions with a specific target (e.g., confederate). Examples of items include, "How willing would you be to go to a movie with this person?" and "How willing would you be to ask this person for advice?" Responses are rated on a 5-point Likert scale from 1 (definitely willing) to 5 (definitely unwilling). Items were reverse-scored for the current study analyses so that higher scores reflected more willingness to interact. Other studies have found support for this measure's reliability and construct validity (Coyne, 1976; Burchill and Stiles, 1988).

#### 2.2.5. Positive reactions to partner (PRP)

The Positive Reactions to Partner (PRP) questionnaire is an 8-item measure, developed for the current study, which assessed the extent to which the participant liked interacting with the confederate (e.g., "I liked talking to my partner," "I trust my partner", "My partner seemed like a warm, caring person," "I enjoyed our conversation," and "I care about how I was perceived by my partner"). Items in this measure were chosen to evaluate the affiliative reactions of participants and their subjective impressions of their partner based on findings that affiliation is tied to factors such as likeability, kindness, and trust (Cottrell et al., 2007). Items were rated on a 5-point Likert scale from 1 (completely agree) to 5 (completely disagree). Items were reverse-scored for the current study analyses so that higher scores reflected more positive reactions toward the confederate. Cronbach's alpha obtained in this study for this scale was adequate,  $\alpha = 0.77$ .

#### 2.2.6. Social skill

Independent undergraduate coders blind to group status rated participants' social skill during the response phase of the social interaction using a social skills manual developed specifically for the current study, which was similar to behavioral rating procedures used in previous social interaction studies (e.g., Penn et al., 1994). Raters coded 2 min and 43 s of each clip to match the duration of the confederate's introduction. To assess the core interpersonal skills involved in social interactions, social skill in the present study was rated based on verbal/conversational content, nonverbal content, affiliation, and overall social skill. Each domain was rated once on a 5-point Likert scale ranging from 1 (poor) to 5 (good).

The verbal content domain refers to the actual content of the person's speech and their ability to fulfill the demands of the task (e.g., appropriate discussion of interests and social activities), rather than the quantity of speech (e.g., number of words). Nonverbal content refers to how the participant speaks (e.g., clarity, fluency, appropriate affect, eye contact). The affiliation rating is an integrative category that takes into account verbal and nonverbal behaviors and rates the participants' degree of engagement and reciprocity with the confederate (e.g., displays friendliness and subjective feelings and attitudes of affection and warmth). Finally, overall social skill referred to a general measure of the participant's social competence and ability to interact in an affiliative and meaningful way, and it subsumed all of the other social skill variables that were coded.

Interrater agreement between coders was established during the training period. Once trained, coders were periodically assessed for coder drift. Interrater agreement for each social skill variable was calculated using intra-class correlations (ICCs). ICCs ranged from 0.87 to 0.93, indicating high agreement between raters. Furthermore, Cronbach's  $\alpha$  for the four social skills domains is 0.92 indicating good internal consistency.

#### 2.2.7. Facial expression coding system (FACES)

Facial expressions in response to the social interaction were rated using FACES (Kring and Sloan, 1991, 1997), a behavioral coding system that provides information about the frequency, intensity, valence, and duration of facial expressions. Raters coded 2 min and 43 s of each clip to match the duration of the confederate's introduction. Several studies have reported high rater agreement (Kring et al., 1993, 1994b; Kring and Neale, 1996; Kring and Earnst, 1999; Salem and Kring, 1999) and validity (Kring et al., 1994b; Sloan et al., 1997, 2001; Kring and Earnst, 2003) for FACES.

In the present study, undergraduate raters blind to group status were trained in FACES, participated in regular consensus meetings, and were periodically assessed for coder drift. These raters were different from raters who coded social skill. ICCs for FACES components ranged from 0.78 to 1.00, indicating high interrater agreement.

#### 2.2.8. Manipulation check

A post-experimental inquiry was used with all participants to identify whether participant behaviors were affected by suspicion of deception rather than a natural response to the manipulation. Experimenters coded whether participants were suspicious of deception or not based on participant reports.

### 2.3. Procedure

After being selected based on their responses to the RSAS, a study coordinator contacted participants. Upon arrival to the study, the participant provided informed consent and was then led to a room with a color television and a video camera. The experimenter read standardized instructions stating that another participant whom he or she was randomly paired with would be introducing him/herself to the participant via closed-circuit video camera, after which the participant would do the same. The participant was instructed to discuss what he/she liked to do in his/her free time with friends and family.

After the confederate's introduction, the television monitor was shut off, and the participant was provided unspecified time to respond. All electronic equipment (e.g., video clip, television monitor) was controlled remotely by the experimenter in order to maintain the pretext of a live interaction. After the simulated social affiliative interaction and completion of self-report measures, participants were fully debriefed as to the true nature of the study.

### 3. Statistical analyses

First, group differences (social anhedonia group vs. control group) on self-reported social functioning and social support were assessed with ANOVAs, and schizotypal personality traits were assessed by conducting a MANOVA (which was followed up by one-way ANOVAs). Second, separate one-way ANOVAs were conducted to assess observer-rated social skill during the social interaction. Third, a repeated measure ANOVA was performed to examine observer-rated facial affect while the participant viewed the confederate's introduction and while the participant responded to the confederate. Fourth, a repeated measures ANOVA was conducted to assess self-reported mood prior to and after the simulated social interaction. Finally, ANOVAs were conducted to assess positive reactions towards the social interaction confederate and willingness to interact with the confederate in the future.

### 4. Results

#### 4.1. Symptom measures

As shown in Table 1, one-way ANOVAs following a significant MANOVA indicated the social anhedonia group was elevated on schizotypal personality traits pertaining to the social domain (anxiety, lack of friends, suspiciousness) compared to the control group, but not to other traits relating to perceptual anomalies or unusual beliefs. A one-way ANOVA showed the social anhedonia group scored higher on depressive symptoms than the control group. Correlations between depression scores and dependent variables (e.g., social skill, PANAS, FACES) were nonsignificant, therefore depression scores were not further considered in analyses.

#### 4.2. Social functioning

As seen in Table 1, results of a one-way ANOVA showed a significant effect of group on social functioning (SAS-SR),  $F(1, 107)=17.74, p<0.001, d=0.80$ . As expected, the social anhedonia group showed more impaired social functioning relative to controls. Separate one-way ANOVAs showed significant effects of group on number of social supports,  $F(1, 107)=9.98, p<0.002, d=0.68$ , and satisfaction with social supports,  $F(1, 107)=8.89, p<0.004, d=0.57$ , reported by participants. As expected, the social anhedonia group reported fewer social supports and less satisfaction with the number of people they can depend on for social support compared to controls.

#### 4.3. Social skill

There was no group difference in the total duration of participant's verbal responses to the video (control,  $M=176.36$  s,  $S.D.=127.30$  s; social anhedonia,  $M=156.60$  s,  $S.D.=80.51$  s,

$t(103)=-0.91, p=0.360$ ). As seen in Table 2, separate one-way ANOVAs showed that the social anhedonia group received lower ratings on verbal content,  $F(1, 103)=6.86, p=0.010, d=0.51$ , affiliation,  $F(1, 103)=6.23, p=0.014, d=0.48$ , and overall social skill,  $F(1, 103)=6.07, p=0.015, d=0.48$ , compared to the control group, but no significant group differences emerged for nonverbal content,  $p=0.071, d=0.35$ . In general, results revealed that the social anhedonia group was rated as less competent in their ability to interact in an affiliative way with the confederate compared to the control group.

#### 4.4. Emotional expressivity

Means and standard deviations are presented in Table 3. First, correlations between the individual FACES variables – computed separately for the social anhedonia group and the control group – were calculated. Within both conditions (viewing the confederate's introduction vs. participant response) positive and negative expression frequency, intensity, and duration were significantly correlated, ranging from 0.40 to 0.90 in the social anhedonia group and from 0.53 to 0.89 in the control group,  $p's<0.05$ . To address this multicollinearity and to reduce the number of dependent variables in this analysis, only frequency ratings were used to assess expressiveness during the social interaction. This procedure has been used with FACES data in studies examining facial expression in individuals with schizophrenia compared to healthy controls (e.g., Aghevli et al., 2003; Kring and Neale, 1996).

**Table 2**

Descriptive statistics for social skill in individuals elevated on social anhedonia and controls.

Variable	SocAnh ( $n=46$ ) <i>M</i> (S.D.), [range]	Control ( $n=59$ ) <i>M</i> (S.D.), [range]	<i>F</i>	Cohen's <i>d</i>
Verbal content	3.86 (0.96), [2–5]	4.30 (0.76), [1.5–5]	<b>6.86*</b>	0.51
Non-verbal content	3.66 (1.17), [1–5]	4.03 (0.86), [2–5]	3.32	0.35
affiliation	3.44 (1.25), [1–5]	3.95 (0.87), [2–5]	<b>6.23*</b>	0.48
Overall social skill	3.62 (1.08), [1–5]	4.08 (0.82), [2–5]	<b>6.07*</b>	0.48

Note: Equipment errors with the digital recording resulted in missing data for four individuals.

\*  $p<0.05$ .

**Table 3**

Descriptive Statistics for FACES Variables in individuals elevated on social anhedonia and controls.

Condition	SocAnh ( $n=44$ ) <i>M</i> (S.D.), [range]	Control ( $n=59$ ) <i>M</i> (S.D.), [range]	Cohen's <i>d</i>
<i>Viewing confederate's introduction</i>			
Positive expression			
Frequency	2.90 (3.93), [0–17]	3.27 (4.86), [0–32]	0.08
Mean intensity	0.69 (0.60), [0–2.3]	0.77 (0.52), [0–1.6]	0.14
Mean duration	9.06 (16.66), [0–75]	9.62 (13.13), [0–59.5]	0.04
Negative expression			
Frequency	0.48 (1.68), [0–9]	0.31 (0.70), [0–3]	0.13
Mean intensity	0.15 (0.38), [0–1.3]	0.22 (0.43), [0–1.5]	0.17
Mean duration	1.41 (5.49), [0–31]	0.65 (1.55), [0–7]	0.19
<i>Participant's response</i>			
Positive expression			
Frequency	5.92 (4.67), [0–20]	6.20 (3.90), [0–14]	0.07
Mean intensity	1.16 (0.33), [0–2.3]	1.09 (0.45), [0–2]	0.18
Mean duration	20.26 (21.35), [0–82]	24.92 (23.49), [0–104.5]	0.21
Negative expression			
Frequency	2.68 (4.16), [0–20]	1.92 (2.69), [0–12]	0.22
Mean intensity	0.74 (0.59), [0–2]	0.69 (0.57), [0–1.8]	0.09
Mean duration	3.89 (6.14), [0–28]	3.23 (6.55), [0–37]	0.10

Note: FACES, Facial Affect Coding System. Equipment errors with the digital recording resulted in missing facial expressivity data for five participants.



For positive facial expression, a repeated-measure ANOVA showed there was a main effect of condition,  $F(1, 101)=32.28, p < 0.001$ , with participants displaying more positive affect while they responded to the confederate ( $M=6.08, S.D.=4.23$ ) than when they passively viewed the confederate ( $M=3.09, S.D.=4.47$ ),  $d=0.69$ . The group main effect,  $F(1,101)=0.21, p=0.648$ , and the Group  $\times$  Condition interaction were nonsignificant,  $F(1, 101)=0.007, p=0.933$ .

For negative facial expression, there was also a main effect of condition,  $F(1, 101)=39.12, p < 0.001$ , with participants displaying more negative affect while they responded to the confederate ( $M=2.24, S.D.=3.40$ ) than when they passively viewed the confederate ( $M=0.38, S.D.=1.21$ ),  $d=0.73$ . Of note, there was a restricted range (0–9) of frequency of negative facial expressions while participants passively viewed the confederate. The group main effect,  $F(1,101)=1.31, p=0.255$ , and the Group  $\times$  Condition interaction were nonsignificant,  $F(1,101)=0.98, p=0.324$ .

#### 4.5. Emotion experience and affiliative responses

Self-reported positive and negative affect in response to the social interaction were measured using the PANAS (see Table 4). A repeated-measure ANOVA showed a significant main effect of time,  $F(1, 107)=4.35, p=0.039$ , with marginal means showing that participants reported higher positive affect after the social interaction ( $M=34.32, S.D.=9.79$ ) compared to baseline ( $M=33.07, S.D.=8.43$ ),  $d=0.14$ . There was a significant main effect of group,  $F(1, 107)=4.38, p=0.039$ . Independent *t*-tests revealed that groups did not differ on baseline positive affect scores,  $p=0.112$ , but the social anhedonia group reported less positive affect after the social interaction compared to the control group,  $t(107)=-2.32, p=.022, d=0.45$ . However, the Group  $\times$  Time interaction was not significant,  $F(1, 107)=2.36, p=0.128$ ; thus, caution is warranted when interpreting the significant group difference in positive affect after the social interaction.

In addition to group differences in overall positive affect, we sought to specifically examine group differences in affiliative feelings. We summed scores on the two adjectives that were added to the PANAS tapping affiliation (*friendly* and *sociable*) (see Table 4). A repeated-measure ANOVA indicated a significant main effect of group,  $F(1,107)=15.69, p < 0.001$ , a significant main effect of time,  $F(1,107)=10.83, p=0.001$ , and a significant Group  $\times$  Time interaction,  $F(1,107)=4.66, p=0.033$ . Independent samples *t*-tests indicated that the control group reported more affiliative feelings than the social anhedonia group at both baseline ( $t(107)=-2.85, p=0.005, d=0.55$ ) and follow-up ( $t(107)=-4.16, p < 0.001, d=0.80$ ). Paired comparisons indicated that the control group reported significantly increased affiliative feelings following the interaction compared to baseline (paired  $t(48)=$

$-3.98, p < 0.001, d=1.15$ ); however, the social anhedonia group showed no change in affiliative feelings from baseline to post-interaction (paired  $t(59)=-0.78, p=0.437, d=0.20$ ).

For negative affect, there was no main effect of time,  $F(1, 107)=3.17, p=0.078$ , no main effect of group, although it approached significance,  $F(1, 107)=3.66, p=0.059$ , and there was no significant Group  $\times$  Negative Affect interaction,  $F(1, 107)=0.04, p=0.838$ .

In terms of self-reported positive reactions in response to the confederate, one-way ANOVAs showed a significant effect of group on positive reactions to the confederate,  $F(1, 107)=7.08, p=0.009, d=0.50$  (see Table 5), with the social anhedonia group reporting fewer positive and affiliative reactions toward the confederate compared to the control group. The social anhedonia group also reported less willingness to interact with the confederate in the future compared to controls,  $F(1, 107)=11.73, p=0.001, d=0.66$ . Thus, the social anhedonia group reported less willingness to engage in a variety of social interactions and situations with the confederate compared to the control group.

#### 4.6. Behavior and subjective experience

We sought to examine if diminished affiliative behavior (measured via the affiliation social skill component) reflected diminished subjective experience of affiliation. Correlations in the full sample indicated that behavioral ratings of affiliation were significantly correlated with post-interaction self-reported total positive affect ( $r=0.37, p < 0.001$ ), the more narrowly measured affiliative feelings (*friendly* and *sociable*;  $r=0.42, p < 0.001$ ), self-reported willingness to interact with the video partner ( $r=0.32, p < 0.001$ ), and self-reported positive reactions to the partner ( $r=0.41, p < 0.001$ ). Similar patterns of results were obtained when examining correlations within the individual groups. These findings indicate that behaviors elicited in the social affiliation interaction task are related to subjective feelings, such that greater affiliative feelings manifested in more social affiliative behavior.

#### 4.7. Manipulation check

Results from the post-experimental manipulation check indicated that there were no significant differences between groups on awareness of deception in the social affiliation task,  $\chi^2(1)=1.66, p=0.249$ , and awareness of deception did not influence group differences in social skill and affiliation, all *p*'s  $> 0.05$ .

### 5. Discussion

This study investigated whether individuals elevated on social anhedonia would be characterized by deficits in social behavior and emotional responding during a novel social affiliative interaction task compared to normally hedonic controls. As hypothesized, and consistent with previous studies (e.g., Blanchard and Brown, 1999; Horan et al., 2007; Blanchard et al., 2011), the social anhedonia group reported fewer people they can depend on for

**Table 4**  
Descriptive statistics for PANAS scores for individuals elevated on social anhedonia and controls.

Time	SocAnh (n=49)	Control (n=60)	Cohen's d
	M (S.D.), [range]	M (S.D.), [range]	
Pre-social interaction			
Positive affect	31.64 (8.45), [17–52]	34.24 (8.30), [12–53]	0.31
Negative affect	17.71 (4.62), [12–30]	16.20 (4.17), [12–27]	0.34
Affiliation	5.82 (1.73), [2–10]	6.77 (1.73), [2–10]	0.55
Post-social interaction			
Positive affect	31.96 (9.88), [15–51]	36.25 (9.35), [12–59]	0.45
Negative affect	16.90 (4.96), [12–37]	15.55 (4.09), [12–27]	0.30
Affiliation	6.00 (2.16), [2–10]	7.65 (1.97), [2–10]	0.80

Note: PANAS, Positive and Negative Affect Schedule. Affiliation scores reflect the summed scores on the two adjectives that were added to the PANAS tapping affiliation (*friendly* and *sociable*).

**Table 5**  
Descriptive statistics for positive reactions to partner (PRP) and willingness to interact (WILL) for individuals elevated on social anhedonia and controls.

Measure	SocAnh (n=49)	Control (n=60)	F	Cohen's d
	M (S.D.), [range]	M (S.D.), [range]		
PRP	25.04 (4.52), [14–34]	27.48 (4.96), [12–34]	<b>7.08*</b>	0.51
WILL	18.69 (4.65), [6–26]	21.82 (4.81), [7–30]	<b>11.73*</b>	0.66

\*  $p < 0.01$ .

social support and less satisfaction with their number of social supports compared to the control group. As noted previously (Blanchard et al., 2011), it is interesting that the social anhedonia group reported less satisfaction with their social support despite the fact that they express a preference to be alone. One possible explanation is that people elevated on social anhedonia may experience their social environments with disinterest and disengagement while also being aware of, and possibly displeased with, their lack of instrumental social support (Blanchard et al., 2011). Additionally, the social anhedonia group differed from their normal hedonic counterparts in their self-reported social functioning, consistent with previous research reporting that social functioning deficits are present in non-clinical individuals elevated on social anhedonia (Kwapil, 1998; Diaz et al., 2002; Blanchard et al., 2011). These findings are important because poor social adjustment prior to the onset of schizophrenia is a robust predictor of more adverse long-term outcomes (Häfner et al., 1999; Paillère-Martinot et al., 2000).

With regard to social behaviors during the social affiliation interaction task, the social anhedonia group was rated as demonstrating poorer social skill compared to the control group. Specifically, the social anhedonia group was rated as less socially skilled in the domains of verbal content (or the appropriate discussion of interests and social activities), affiliation (or the extent to which they demonstrate engagement and involvement in a social interaction), and overall social skill. These findings are consistent with studies of college students in which high anhedonia was related to various indices of decreased social competence (Haberman et al., 1979; Chapman et al., 1980; Numbers and Chapman, 1982; Beckfield, 1985) however, the methodology of these studies differed from the current study in that participants were also high on physical anhedonia and these studies used role-play responses to problematic academic and interpersonal relationships to measure social competence. Results of the current study suggest that people elevated on social anhedonia are less skilled during social interactions and this may be detrimental to their social relationships since peers may respond negatively or wish to no longer interact with people who display deficient social skills (South et al., 2005). An alternative explanation is that people elevated on social anhedonia enjoy social interactions less than their healthy counterparts (as addressed below), and thus they are less likely to demonstrate affiliative social behaviors that would facilitate social interactions (e.g., lack of engagement and involvement during conversations).

With reference to behavioral displays of emotion, the current findings demonstrated that the social anhedonia group and the control group displayed comparable facial expressions while viewing the confederate's introduction and while responding to the confederate. This observation is inconsistent with previous research finding that non-clinical individuals elevated on social anhedonia are less facially expressive than controls in response to emotionally evocative film clips (Leung et al., 2010) and during a clinical interview (Collins et al., 2005). Interestingly, our results showed that all participants displayed more positive facial expressions while they responded to the participant, which involved active communication, as opposed to passively viewing the confederate. It may be that individuals elevated on social anhedonia understand social norms and produce socially appropriate levels of expressivity in response to a social situation in which they know they are being monitored. For example, studies have shown that the intensity of emotional facial expressions are better predicted by the social context than by emotional state (Fridlund, 1991; Fridlund et al., 1992).

Another study aim sought to examine subjective experiential responding to the social affiliation interaction task. With regard to the manipulation of emotion, it is clear from the results that the simulated social affiliative interaction produced significant

changes in the participants' mood, with higher positive affect scores occurring after the social affiliative interaction. Group comparisons indicated that the social anhedonia group reported less positive emotions in response to the social interaction compared to the control group. This finding implies the social anhedonia group may not have been emotionally affected by the social interaction, instead their baseline level of positive affect remained constant following the social interaction. Focusing on more narrowly assessed affiliative feelings within positive affect, we found that the social anhedonia group reported less subjective affiliative feelings than the control group both at baseline and follow-up. Importantly, while the control group showed an increase in affiliative feelings after the social interaction task, the social anhedonia group showed no such change. In terms of other reactions to the video partner, compared to controls individuals elevated on social anhedonia reported less positive reactions (e.g., seeing the partner as warm and caring) toward the confederate and less willingness to interact with the confederate in the future. The current study's findings are consistent with other studies of non-clinical samples reporting that decreased positive affect intensity related to social anhedonia occurs across a variety of settings and stimuli (Brown et al., 2007, 2008; Kerns et al., 2008) and extends these findings to affective and affiliative reactions to a social interaction.

In normally hedonic individuals affiliative bonds are maintained across two phases of reward, namely appetitive and consummatory processes (Depue and Morrone-Strupinsky, 2005; Depue, 2006). Deficits in these two processes may characterize individuals elevated on social anhedonia. Results of the current study indicating unchanged affiliative feelings following the interaction and less positive reactions to the partner in the social anhedonic group are consistent with lowered consummatory responses. Findings of diminished willingness to interact further with the social partner in the social anhedonia group may also indicate diminished anticipatory pleasure (as reflected in ratings of less desire for future interaction). However, we did not directly examine anticipatory pleasure beyond these behavioral-related questions of future interaction so these results should be interpreted with caution. Nonetheless, the current findings indicate broad differences in affiliative responding that are evident in individuals with elevated social anhedonia. We also examined the relationship between behavioral rating of affiliations (rated blind to group status or self-report responses) and subjective responses to the affiliative stimulus. Behavioral ratings of affiliation were correlated with all self-report domains such that greater behavioral displays of affiliation was associated with more positive and affiliative affect, more positive reactions to the interaction partner, and a greater willingness to interact with the partner in the future. These findings indicate that the behavioral differences observed between groups do not merely reflect a skills deficit but, at least in part, reflect subjective affiliative feelings. The group differences observed, and behavioral correlates with subjective experience, provide encouraging support for the social affiliation interaction task as a novel method to assess affiliation within the lab using a standardized affiliative stimulus.

In summary, the results of the current study suggest that social anhedonia may be characterized by a pattern of emotional disturbance and social skill impairments during affiliative social interactions, which include impaired social skill, reduced emotional responsiveness, yet intact emotional expressivity. A potential limitation of the current study is that the effects of same sex and opposite sex interactions could not be examined. Nevertheless, a female confederate was chosen as opposed to a male confederate given research suggesting that women report greater self-disclosure (Cozby, 1973), friendliness, empathy, altruism (Gibbs et al., 1980), and interpersonal affection (Aries, 1976) within same-sex friendships compared to males. The current study provides support for the use of a social affiliation interaction task for investigating

subjective and behavioral responding in laboratory settings in which participants are socially engaged with an affiliative stimulus. Future research using this paradigm should focus on replicating these findings and establishing the psychometric properties of this stimulus, and current efforts are underway to extend this paradigm for use in schizophrenia samples.

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