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Selective attention to affective stimuli and clinical depression among youth: Role of anxiety and specificity of emotion

Benjamin L. Hankin,
University of Denver

Brandon E. Gibb,
Binghamton University

John R. Z. Abela, and
Rutgers University

Kate Flory
University of South Carolina

Abstract

Cognitive models of psychopathology posit that the content or focus of information-processing biases (e.g., attentional biases) is disorder-specific: Depression is hypothesized to be characterized by attentional biases specifically for depression-relevant stimuli (e.g. sad facial expressions), whereas anxiety should relate particularly to attentional biases to threat-relevant stimuli (e.g., angry faces). However, little research has investigated this specificity hypothesis, and none with a sample of youth. The present study examined attentional biases to emotional faces (sad, angry, and happy compared with neutral) in groups of pure depressed, pure anxious, comorbid depressed and anxious, and control youth (ages 9–17; $N = 161$). Consistent with cognitive models, pure depressed and pure anxious youth exhibited attentional biases specifically to sad and angry faces, respectively, while comorbid youth exhibited attentional biases to both facial expressions. In addition, control youth exhibited attentional avoidance of sad faces, and comorbid boys avoided happy faces. Overall, findings suggest that cognitive biases and processing of particular emotional information are specific to pure clinical depression and anxiety, and results inform etiological models of potentially specific processes that are associated with internalizing disorders among youth.

Major depressive disorder (MDD) is a common disorder with increasingly higher prevalence rates starting in adolescence (Avenevoli et al., 2008; Costello et al., 2003; Hankin et al., 1998). Depression frequently co-occurs with other psychiatric disorders, especially anxiety disorders (median odds-ratio of 8.2; Angold, Costello, & Erkanli, 1999). Comorbid depression is associated with more severe symptoms, consequences, and worse clinical course and potential treatment outcomes (Birmaher et al. 1996; Lewinsohn et al. 1995). However, the specificity of etiological processes that are associated with pure clinical depression compared with depression comorbid with anxiety disorders is not well understood, and enhanced

Correspondence concerning this article should be addressed to Benjamin L. Hankin, Department of Psychology, University of Denver, 2155 South Race Street, Denver CO 80208. Internet correspondence can be addressed to ben.hankin@psy.du.edu.

understanding of common and specific causal mechanisms would improve knowledge on the pathophysiology of depression and the comorbidity with anxiety.

Cognitive theorists (e.g., Clark, Beck, & Alford, 1999; Williams, Watts, MacLeod, & Mathews, 1997) have proposed that individuals' characteristic ways of attending to, interpreting, and remembering events in their lives may contribute to the development and maintenance of psychopathology. Information-processing biases are hypothesized to characterize various psychiatric disorders, and the content or focus of these biases is hypothesized to be disorder specific. For example, depression is hypothesized to be characterized by biases specifically for stimuli conveying themes of hopelessness or loss, whereas information-processing biases in anxiety are hypothesized to be specific to threat-relevant stimuli. Although not specifically addressed in these theories, one would predict that comorbid depression and anxiety would be characterized by biased processing of both types of stimuli.

There is growing support for cognitive models of depression among youth (for reviews, see Abela & Hankin, 2008; Lakdawalla, Hankin, & Mermelstein, 2007). A limitation of this research however, is that most of the studies have employed self-report assessments of cognitive vulnerability, and such questionnaires may be biased by mood or personality characteristics. Moreover, many of the hypothesized cognitive risk mechanisms (e.g., encoding, attention, memory) cannot be tested easily or potentially accurately via explicit self-report measures as these cognitive processes are hypothesized to function outside individuals' awareness (Gotlib & Neubauer, 2000). Further, relatively little research has investigated whether the cognitive processes hypothesized to contribute to depression are, in fact, specific to depression compared with anxiety problems among youth (see Hankin, 2008a,b; Lewinsohn, Seeley, & Gotlib, 1997, for some exceptions with self-report measures of cognitive vulnerabilities).

In the current study, we sought to address several novel questions to advance understanding of the specific influence that biased information processing may exert in youth depression specifically compared with anxious youth or those with depression comorbid with anxiety disorders. In particular, we examined: (1) whether attentional biases are specific to pure depression compared with pure anxiety and comorbid depression and anxiety and (2) whether selective attention effects for these different groups vary depending on the affective stimulus (sad, angry, and happy faces compared to neutral).

Several theoretical perspectives proffer hypotheses on how attentional biases may differ by diagnostic group and affective stimulus. First, as noted earlier, cognitive theorists (e.g., Beck, Brown, Steer, Eidelson, & Riskind, 1987; Clark et al., 1999; Williams et al., 1997) posit that information processing biases in depression should be specific to stimuli conveying sadness, loss, or hopelessness, whereas cognitive biases in anxiety should relate to threat. Second, and consistent with cognitive theories, emotion theory postulates that negative and positive emotions play a prominent role in depression (Clark, 2005). Higher levels of negative emotion, such as anger, are hypothesized to characterize both depression and anxiety, whereas depression is differentiated relatively more by reduced levels of positive emotion (Clark, 2005; Clark & Watson, 1991) and a predominant emphasis of sadness as a core emotional feature (Cole, Luby, & Sullivan, 2008). Third and related to hierarchical models of emotional disorders, structural models of personality factors predisposing for anxiety and depression (e.g., Brown, Chorpita, & Barlow, 1998; Mineka, Watson, & Clark, 1998) would similarly organize how attentional biases would relate to specific emotional face types. In these hierarchical personality models, neuroticism is posited to be nonspecifically related to both anxiety and depression, whereas low levels of extraversion are postulated to uniquely relate to depression. Several adult studies of information processing have supported these hierarchical models, based on emotion and personality factors, being associated differentially with anxiety and

depression (e.g., Yovel & Mineka, 2004, 2005; see review by Mineka, Rafaeli, & Yovel, 2003). In sum, these different theoretical perspectives converge on the notion that depression should be characterized by attentional biases to stimuli emphasizing sadness, whereas anxiety should be characterized by preferential attention to threat and angry faces. The extant evidence reviewed next, largely based on adult samples, is consistent with these perspectives.

Research among adults has been consistent in showing that those with current or past major depression exhibit attentional biases for sad facial expressions (Gotlib, Kasch, Traill, Joormann, Arnow & Johnson, 2004; Gotlib, Krasnoperova, Yue, & Joormann, 2004; Joormann & Gotlib, 2007). To date, however, only two studies (Gibb, Benas, Grassia, & McGeary, 2009; Joormann, Talbot, & Gotlib, 2007) have examined depression-related attentional biases to facial displays of emotion in youth. Both studies tested attentional biases among high-risk samples, specifically offspring of depressed mothers (all girls ages 9–14 in Joormann et al., 2007; boys and girls ages 8–12 in Gibb et al., 2009). Although both studies found that children of mothers with a history of major depression, compared to children of control mothers, exhibited attentional biases specifically for sad faces, the direction of the attentional biases observed in the two studies was in the opposite direction. Specifically, Joormann and colleagues (2007) found that high-risk girls, whose mothers had a history of recurrent depression, exhibited preferential attention toward sad faces compared to control girls, whose mothers had no prior depression. In contrast, Gibb and colleagues (2009) showed that children of previously depressed mothers deployed attention away from sad faces. The exact reason for this discrepancy is unclear. The only methodological difference in the assessment of attentional biases was that Joormann and colleagues utilized a mood induction procedure prior to assessing attentional biases based on cognitive theory suggesting that these biases remain latent until "activated" by a negative mood.

In terms of attentional biases in anxiety disorders, past research among adults (e.g., MacLeod, Mathews, & Tata, 1986; MacLeod, Soong, Rutherford, & Campbell, 2007; Mogg, Bradley, & Williams, 1995) and youth (see reviews by Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Lau & Pine, 2008) generally shows that individuals with elevated anxiety symptoms or diagnosed with anxiety disorders allocate attention toward threatening and fearful stimuli, and this bias is specific to threat-relevant rather than sad, stimuli. We should note that studies examining attentional biases in anxiety present stimuli for relatively shorter durations (often 500 miliseconds or less; Bar-Haim et al., 2007), and that studies utilizing longer stimulus presentation durations have generally not found evidence of attentional biases to threat (e.g., Ioannou, Mogg, & Bradley, 2004; Mogg Philippot, & Bradley, 2004). In contrast, the strongest support for attentional biases in depressed individuals has been observed at a relatively longer stimulus presentation duration (1000 ms), which is consistent with the hypothesis that depression is associated with difficulty disengaging attention from affectively-salient information (for reviews, see Joormann, 2009; Mathews & MacLeod, 2005).

In contrast to the large number of studies examining attentional biases specifically in depressed or anxious groups, relatively few have evaluated the potential impact of diagnositic comorbidity on attentional biases. This research has primarily focused on words as the stimuli, not emotional faces, and has yielded mixed results (e.g., Dalgleish et al., 2003; for a review, see Mathews & MacLeod, 2005). However, theory and research suggest that attentional bias to emotional faces, rather than verbal stimuli, provides a more accurate and ecologically valid test of biased information processing (Bradley et al., 1997; McNally, Riemann, & Kim, 1990).

To date, no study has examined attentional biases to emotional faces in a group of comorbid anxious and depressed youth along with diagnostically pure depressed, pure anxious, and

psychiatrically healthy youth. Indeed, in their recent review, Bar-Haim and colleagues (2007) note that it is unclear how attentional biases function in individuals with comorbid depression and anxiety. Given that comorbid youth exhibit more impairment in many domains and greater distress than youth with pure depression (Birmaher et al., 1996), youth with comorbid depression and anxiety may exhibit a different pattern of selective attention compared with controls, purely depressed, or purely anxious youth. Drawing from cognitive, emotion, and personality theories of psychopathology, one would hypothesize that youth with comorbid depression and anxious diagnoses would exhibit attentional biases to both sad and angry faces. Examining the specificity of selective attention to different affective stimuli can inform theories on the interplay of cognition and emotion and expand understanding of biased information processing in the internalizing spectrum disorders of anxiety and depression.

The current study

The role of attentional biases to affective stimuli among youth with clinical depression remains unclear. This study sought to address various lacunae in knowledge by investigating selective attention to different affective stimuli (sad, angry, and happy faces paired with emotionally neutral faces) to advance an understanding of the role that attentional processes may play in youth depression. The primary aim of this study was to investigate attentional biases in depressed youth. The secondary aim was to examine whether selection attention to emotional faces differs for purely depressed compared with purely anxious as well as comorbid depressed and anxious youth. The relative lack of attentional bias research in depressed youth, the equivocal pattern and direction of findings in this area, the dearth of research investigating specificity to depression versus comorbidity with anxiety in youth, and the uncertain specificity to different affective stimuli (sad, angry, happy) motivated the present study.

We hypothesized that purely depressed youth would exhibit attentional bias specifically to sad faces, purely anxious youth would attend specifically to angry faces, and the comorbid group would preferentially attend to both sad and angry faces. We used the visual dot-probe task to evaluate the direction of potential attentional biases to different affective stimuli in groups of pure clinically depressed, pure anxious, comorbid depressed and anxious, and psychiatrically healthy control adolescents. In this study, we were primarily interested in attentional biases and specificity to affective stimuli among clinically depressed youth, so we used the longer stimulus presentation (i.e., 1000 ms). Finally, potential moderation by sex and age was explored given well-known sex and age effects in the development of depression throughout adolescence (e.g., Hankin & Abramson, 2001) and the opposite direction of findings in the two past youth studies (girls only in Joormann et al., 2007; boys and girls in Gibb et al., in press).

Method

Participants and Procedure

Participants were 161 children and adolescents (53% girls) between the ages of 9 and 17 (*M* age = 12.68, *SD* = 2.16) who were involved in research investigating adolescent socio-emotional development and risk factors for the development of psychopathology from childhood through adolescence. The sample was 67% Caucasian, 32% African-American, and 1% of youth were from other racial/ethnic groups. Parents reported an average educational attainment of “some college or a 2-year degree” and an average yearly household income of $41,000 to $60,000.

These youth were assessed for current and past clinical depression as well as anxiety disorders via standardized, valid semi-structured diagnostic interviews (see Measures section below for details). Based on their diagnostic status, four groups of youth were created for this study: participants diagnosed with (1) a pure diagnosis of clinical depression without comorbid

anxiety (*n*=29), (2) a pure anxiety disorder without comorbid depression (*n*=21), (3) a comorbid depressed and anxious group (*n*=14), and (4) a psychiatrically healthy group with no current or lifetime diagnosis of depression or anxiety (*n*=97).

Multiple recruitment methods were used to solicit participants. These included letters sent home to parents of youth in public schools, flyers posted in community locations (e.g., stores, libraries, community bulletin boards) and pediatric or orthodontic (but not psychiatric) clinics, advertisements placed in local newspapers, and emails distributed through university and college list-serves. Interested participants called the lab. A brief screening was conducted with parents to determine the eligibility of their child. Youth had to be between ages 9 and 17. They were excluded if they had a severe learning or psychiatric problem (e.g., autism, psychosis) that was likely to interfere with completion of an extensive laboratory protocol; no child was excluded. Each eligible child, along with one parent (mothers in most cases), were scheduled for a laboratory visit.

Parents provided informed written consent for their participation and for their child; youth provided written assent. Trained graduate students and staff administered the interviews and measures. All procedures were approved by the Institutional Review Board. Youth and parents were reimbursed $30 each for their participation. The dot probe task was administered in the same session that the questionnaires and diagnostic interviews were completed. The dot probe task was the only information processing task administered in this study. Youth completed the task on an IBM-compatible desktop computer with a Dell 20-inch color monitor. E-Prime software was employed to control presentation of stimuli and record response accuracy and latency. All aspects of task administration and computer set-up were consistent with prior investigations of attentional biases among youth (e.g., Gibb et al., 2009).

Measures

Depression diagnoses—The Kiddie Schedule for Affective Disorders and Schizophrenia-Present and Lifetime Version (KSADS-PL; Kaufman et al., 1997) was used to assess past and present *DSM-IV* (American Psychiatric Association, 1994) diagnoses of major (MDD) or minor (mDD) depressive disorder among youth. In addition to the mood modules (i.e., mania, hypomania, MDD, mDD, dysthymia), the psychotic screen was used to rule out adolescents with a psychotic disorder, but none met criteria. The KSADS is a semi-structured interview designed specifically to arrive at the diagnosis of mood disorders, and other psychiatric disorders, in children and adolescents. It is the most frequently used, most studied diagnostic interview with youth and has demonstrated strong evidence of reliability and validity (Kaufman et al., 1997; Klein, Dougherty, & Olino, 2005). Diagnostic interviewers completed an intensive training program for administering the KSADS interview and for assigning DSM-IV diagnoses. The training program consisted of attending a minimum of 40 hours of didactic instruction, listening to audiotaped interviews, and conducting practice interviews. The first author (BLH) held weekly supervision sessions for the interviewers. The first author also reviewed interviewers' notes and tapes in order to confirm the presence or absence of a diagnosis. Adolescents and parents completed the KSADS interview separately. Discrepancies were resolved through consensus meetings and best estimate procedures, in which the diagnostician uses his or her best judgment to integrate and adjudicate disagreements in diagnostic information provided by youth and parents. The best estimate approach has been shown to be a reliable and valid approach to integrating data from different informants (Klein, Dougherty, & Olino, 2005; Klein, Ouimette, Kelly, Ferro, & Riso, 1994). The youth were interviewed for past and current depressive disorders. In this sample, 26.7% (*n*=43) received a diagnosis of clinical depression. Of these, 17 met criteria for current and 26 for past depressive disorder; 5% reported receiving psychotherapy or counseling over their lifetime, and none

endorsed lifetime antidepressant treatment. Inter-rater reliability for the K-SADS, based on 20% of the sample interviews (*n*=32) was good (kappa = .87).

Anxiety diagnoses—The Anxiety Disorders Interview Schedule for *DSM-IV:* Child and Parent Versions (ADIS C/P; Silverman & Nelles, 1996) (referred to hereafter as ADIS) were used to diagnose youth with anxiety disorders, specifically separation anxiety disorder, social anxiety disorder, generalized anxiety disorder, panic disorder, and post-traumatic stress disorder, according to *DSM-IV* criteria. The ADIS is a semi-structured interview designed specifically for the diagnosis of anxiety in children and adolescents. It is the most frequently used, most studied diagnostic interview with youth, and has demonstrated strong evidence of reliability and validity (Silverman & Ollendick, 2005; Silverman, Saavedra, & Pina, 2001). As with the KSADS, interviewers completed a comprehensive diagnostic training program in the ADIS, weekly supervision sessions were held, and interviewer's information was reviewed to confirm anxiety diagnoses. Both the child (Child version) and the parent (Parent version) were administered separately, and both informants were used to arrive at any potential anxiety diagnoses according to best estimate procedures. In administering the child and parent interviews, *DSM-IV* symptoms are judged by the child and parent as either present ("yes") or absent ("no"). If the number of symptoms endorsed as present is sufficient to meet *DSM-IV* criteria, the child and/or parent is then asked whether those symptoms, taken together, lead to significant clinical interference or impairment in important domains of the child's life that include school, family life, or peers. Impairment ratings are made by the children and parents using a 9-point Feelings Thermometer scale (i.e., 0–8). To warrant a final anxiety diagnosis on the child and/or parent interview, the child needs to meet the minimum number of required symptoms for the anxiety disorder, according to *DSM-IV*, and receive an impairment rating for each diagnosis of 4 or greater (i.e., leads to at least "some" or a moderate degree of impairment). In this sample, 22% (n=35) received lifetime criteria for one or more anxiety disorders (n=23 with a current diagnosis). Regarding specific anxiety diagnoses, 5% met criteria for a lifetime diagnosis of separation anxiety disorder (none current), 8% for social anxiety disorder (n= 12 current), 8% for generalized anxiety disorder (n= 11 current), and none were diagnosed with panic or post-traumatic stress disorder. Inter-rater reliability for ADIS, based on 20% of the sample interviews (n=32), was good (kappa = .78).

Children's Depression Inventory (CDI; Kovacs, 1985)—The CDI is a self-report measure that assesses depressive symptoms in children and adolescents using 27 items. Each item is rated on a scale from 0–2. Reported scores are mean of all items and range from 0–54. Higher scores indicate more depressive symptoms. The CDI has been shown to have good reliability and validity as a measure of depressive symptoms in youth (Klein, Dougherty, & Olino, 2005). Internal reliability in this sample was $\alpha = .90$.

Revised Children's Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 1985)—The RCMAS is a 37-item self-report measure that assesses various anxiety symptoms with a Yes/No format. The three anxiety subscales, physiological anxiety, worry/ oversensitivity, and social concerns/concentration, were added together to form an overall total anxiety score that was used in analyses. The RCMAS total anxiety score has shown adequate reliability and good validity, and it is the most used self-report measure of anxiety among youth (Silverman & Ollendick, 2005). Coefficient alpha in this study was $\alpha = .83$.

Attentional biases—Youths' attentional biases for facial displays of emotion were assessed using a modified dot-probe task (cf. MacLeod, Mathews, & Tata, 1986) administered using E-Prime (Psychological Software Tools, 2002). The key aspects of the task were identical to those used in previous studies examining selective attention to affective faces (e.g., Gibb et al., 2009). Stimuli for the dot-probe task consisted of pairs of facial expressions that contained one

affective (sad, happy, or angry) and one neutral photograph from the same actor taken from a standardized stimulus set (Tottenham et al., 2009). Photographs from each actor (16 males and 16 females) were used to create sad-neutral, happy-neutral, and angry-neutral stimulus pairs (96 pairs total). Neutral-neutral pairings were not used given time constraints and concerns about participant fatigue.

Each stimulus pair was presented in random order over the course of two blocks, with a rest in between blocks, for a total of 192 trials. Each youth was presented with a new, fully randomized order of stimuli. Participants had 12 practice trials of the dot probe task, with the experimenter present in the room sitting neutrally behind the child, to ensure the child understood the task and could complete it appropriately. Each trial began with a blank computer display with only a white fixation cross in the middle of the screen for 1000 ms. Then, a pair of pictures (one neutral, one showing an emotional expression of sad, angry, or happy) from the same actor was presented for 1000 ms. As noted earlier, a 1000 ms stimulus presentation duration was chosen for the current study because our primary purpose was to investigate attentional biases in depression, and prior research with depression has suggested that attentional biases are most likely to occur at this time interval (for a review, see Mathews & MacLeod, 2005). Following the offset of the pictures, both photographs of actors' faces (an affective and a neutral picture) disappeared and were replaced by a dot where one of the prior pictures had been (either affective or neutral). Youth were instructed to indicate as quickly as possible the location of the dot (left vs. right side of the screen) using the computer keyboard ("z" labeled "left"; "/" labeled "right"). The computer recorded the accuracy and response time for each response. In each pair, the affective face was presented with equal frequency on the left and right side of the screen, and the probe occurred with equal frequency in the location of the affective and neutral faces. The intertrial interval was 1000 ms. Trials with response errors were excluded as were trials with response times less than 150 ms or greater than 1500 ms. Error rates were quite low (less than 1.5%), and a small portion (1.8%) were excluded for being out of response time range; neither differed by diagnostic group. Mean attention bias scores (Mogg, Bradley, & Williams, 1995) were then calculated separately for each affective stimulus type (sad, happy, angry face) by subtracting the mean response time for cases in which the probe replaced the affective face from mean response times for cases in which the probe replaced the neutral face. Positive bias scores represent preferential attention toward the affective face; negative scores indicate attentional avoidance of the affective face.

RESULTS

Group characteristics

Demographic and clinical characteristics of the four diagnostic groups (pure depressed, pure anxious, comorbid depressed and anxious, and psychiatrically healthy controls) are presented in Table 1. There were no significant differences in age, sex, or ethnicity among the diagnostic groups. CDI scores were significantly higher among the clinical groups compared with healthy controls, although CDI scores did not differ across clinical groups. RCMAS anxiety scores were higher for the pure anxious and comorbid groups compared with healthy controls and pure depressed groups.

Attention bias scores and diagnostic status groups

To examine the primary question that youth from these four diagnostic groups may differ in selective attention to different affective facial stimuli, we conducted a 4 (diagnostic group) × 3 (face emotion type) repeated measures analysis of variance (ANOVA) on the attention bias scores as the dependent variable. Results showed that the face type × diagnostic group interaction was significant ($F(6, 314) = 2.67$, $p < .05$, $\eta_p^2 = .06$). Follow-up ANOVAs were conducted within each diagnostic group for each face emotion type. Results revealed a

significant main effect for diagnostic group for angry faces ($F(3, 160) = 3.0$, $p < .05$, $\eta_p^2 = .06$) and sad faces ($F(3, 160) = 3.45$, $p < .05$, $\eta_p^2 = .07$). Sex did not moderate these relations as the sex × diagnostic group interactions were not significant (F's < 1.2; *ns*). For happy faces, there were significant main effects for diagnostic group ($F(3, 160) = 3.13$, $p < .05$, $\eta_p^2 = .08$) and sex ($F(1, 160) = 6.42$ $p < .01$, $\eta_p^2 = .07$), but these were qualified by a significant sex × diagnostic group interaction ($F(3, 160) = 3.89$, $p < .01$, $\eta_p^2 = .10$). The repeated measures ANOVA examining potential moderation by age (age × group × emotion face type) was not significant ($F < 1.0$). The group × emotion face type interaction remained significant ($F(6, 314) = 2.96$, $p < .05$, $\eta^2 = .06$).

Planned follow-up analyses were then conducted to break down the significant main effects for angry and sad faces. The descriptive data for these diagnostic groups overall are shown in Table 2 (top panel). As seen in Figure 1 (top portion), the pure depressed group exhibited greater attention to sad faces than controls ($p < .05$, $d = .83$) and the pure anxious group ($p < .05$, $d = .32$). The pure anxious group preferentially attended to angry faces compared to controls ($p < .05$, $d = .59$) and pure depressed ($p < .05$, $d = .68$). In addition, the comorbid group exhibited greater attention to angry faces than the control participants ($p < .05$, $d = .50$) and the pure depressed group ($p < .05$, $d = .32$) as well as more attention to sad faces compared with the control youth ($p < .05$, $d = .44$). Effect sizes (Cohen, 1988) can be interpreted as small ($.2 < d < .5$), medium ($.5 < d < .8$), and large ($d > .8$) effect.

Although the preceding analyses indicate significant group differences, they do not demonstrate which of the groups may be exhibiting the attentional bias (cf. Gotlib, McLachlan, & Katz, 1988). To examine whether the significant group difference was due to only one group showing a bias or both groups showing a bias to varying degrees, we conducted one-sample *t* tests to determine whether the attentional bias scores within each group differed significantly from zero. The depressed group exhibited preferential attention toward sad faces ($t(28) = 2.16$, $p < .05$, $d = .83$). The pure anxious group exhibited preferential attention toward angry faces ($t(20) = 3.15$, $p < .01$, $d = 1.38$). The comorbid group exhibited preferential attention toward angry faces, $t(13) = 2.03$, $p < .05$, $d = 1.08$, but not to sad faces ($t = 1.43$; $d = .79$). Control youth exhibited attentional avoidance of sad faces, $t(96) = -3.71$, $p < .001$, $d = .76$, but not angry ($t = .93$; $d = .18$). In sum, the group differences can be accounted for by control youth avoiding sad faces, purely depressed youth attending selectively to sad faces, purely anxious attending to angry faces, and the comorbid group selectively attending to angry faces.

Next, planned follow-up analyses were conducted to break down the significant sex X group interaction for happy faces. Figure 2 shows the attentional bias reaction times to happy faces decomposed by sex and diagnostic group. One-way ANOVAs for attention bias scores for happy faces, analyzed separately for boys and girls, showed significant group differences for boys ($F(3, 73) = 5.2$, $p < .01$, $\eta_p^2 = .20$) but not for girls ($F(3, 84) = .14$, $p = .93$, $\eta_p^2 = .003$). Follow-up analyses for the boys revealed significant differences between the control and comorbid youth ($t(76) = 3.22$, $p < .01$, $d = .75$), the pure depressed and the pure anxious ($t(76) = 2.08$, $p < .05$, $d = .49$), and the pure depressed versus the comorbid group ($t(76) = 3.33$, $p < .01$, $d = .78$). Last, one-sample t-tests were conducted to examine whether these attentional biases to happy relative to neutral faces differed significantly from zero for the different diagnostic groups of boys. Control ($N = 36$), pure depressed ($N = 6$), and pure anxious boys ($N = 3$) did not differ significantly from 0 (ts < 1.7), whereas comorbid boys significantly avoided happy faces ($t(4) = -2.87$, $p < .05$, $d = 2.8$). Clearly, some caution is needed in interpreting these analyses given the rather small sample sizes of diagnostic groups among only boys.

Finally, correlation analyses were conducted for attention bias scores and self-reported depressive and anxious symptom scale scores. No significant correlations were observed

between CDI and bias scores (r = .06 with angry faces, r = −.12 with happy faces, and r = .05 with sad faces). Correlations for bias scores and RCMAS yielded a significant association between attentional bias to angry faces (r = .22, p < .05) but not for happy (r = −.06) or sad (r = −.004) faces. Finally, there were no significant correlations between age and attention bias scores (r = −.03 with angry faces, r = .01 with happy faces, and r = −.10 with sad faces).

Attention bias scores and diagnostic status groups: Influence of current depression

These analyses examined attention bias scores as a function of diagnostic status but did not explicitly investigate selective attention for currently depressed and anxious youth. We conducted similar analyses as above except that we examined currently and purely depressed, purely anxious, and comorbid groups. We also report data on previously purely depressed youth as attentional bias among remitted depressed youth is of interest (cf., Joormann & Gotlib, 2007, for data with remitted depressed adults). Table 2 (bottom portion) shows the attention bias scores for different face types and sample sizes for these groups. The primary analysis to examine selective attention to emotion faces among currently disordered youth involved a 4 (diagnostic group) × 3 (face emotion type) repeated measures analysis of variance (ANOVA) on the attention bias scores as the dependent variable; this was significant (F(6, 250) = 2.88, p < .05, η_p^2 = .06). Follow-up ANOVAs were conducted with diagnostic group entered as the independent variable for each face emotion type. A significant main effect for diagnostic group was observed for angry faces (F(3, 128) = 2.4, p < .05, η_p^2 = .04) and sad faces (F(3, 128) = 2.9, p < .05, η_p^2 = .06), but not to happy faces (F(3, 128) = 1.5, η_p^2 = .01). Sex did not moderate any of these relations as the sex × diagnostic group interactions were not significant (F's < 1.5; *ns*).

Results from planned follow-up analyses are shown with the descriptive data for attention bias scores for these currently disordered groups along with remitted depressed youth in Table 2 (bottom panel). As seen in Figure 1 (bottom panel), the pure current depressed youth (p < .05, d = .73), pure past depressed youth (p < .05, d = .75), and currently depressed comorbid group (p < .05, d = .71) exhibited greater attention to sad faces compared to controls. Moreover, the pure current depressed youth (p < .05, d = .52), the pure past depressed youth (p < .05, d = .54), and the currently comorbid group (p < .05, d = .32) exhibited greater attention to sad faces compared to pure current anxious youth. Next, the currently comorbid group exhibited greater attention to angry faces compared with the purely currently depressed (p < .05, d = .34) and the pure past depressed (p < .05, d = .36) groups. Finally, the currently pure anxious group significantly attended to angry faces compared with pure current depressed (p < .05, d = .80), pure past depressed (p < .05, d = .86), and control (p < .05, d = .72) youth.

Last, we explored whether age of onset for disorder was associated with attentional bias to emotion face type. No significant correlations were found for lifetime anxiety disorders (r = −.25 for angry, r = −.02 for happy, and r = .02 for sad). Of interest, however, age of onset for lifetime clinical depression correlated with attentional bias to angry (r = .36) and sad (r = −.42), but not happy (r = −.10), faces. Youth who had their first onset of depression at a younger age were more likely to attend to sad faces and avoid angry faces.

DISCUSSION

The present study sought to investigate selective attention to different emotion faces – specifically angry, happy, and sad – in different diagnostic groups of youth, including pure depressed, pure anxious, comorbid depressed and anxious, and psychiatrically healthy control participants. No prior study had examined attentional biases to emotional faces among purely clinically depressed youth, and no research had investigated specificity of selective attention to different affective faces among a group of comorbid depressed and anxious youth. Regarding these critical questions, we found that purely depressed youth preferentially attended to sad

faces, purely anxious youth preferentially attended to angry faces, currently comorbid depressed and anxious youth preferentially attended to both sad and angry faces, control youth avoided sad faces, and comorbid boys, but not girls, avoided happy faces. These results were observed when we focused on youth's lifetime history of depressive and anxiety disorders and when we focused specifically on current diagnoses, although these findings should be considered tentatively given relatively small sample sizes for the currently pure depressed and comorbid groups. Overall, these findings advance knowledge on the role that selective attention to salient affective stimuli plays in depression and anxiety among youth.

The present study's findings replicate the selective attention research with clinically depressed adults and extend it to diagnoses of depression among youth. Seminal research by Gotlib and colleagues indicates that currently depressed (Gotlib, Kasch, et al., 2004; Gotlib, Krasnoperova, et al., 2004) as well as remitted depressed (Joormann & Gotlib, 2007) adults selectively attend to sad faces. Despite this well-replicated pattern of attentional biases to sad faces among depressed adults, the applicability of this finding to clinically depressed youth was unclear. Although two studies found evidence for attentional biases specifically for sad faces among children of depressed mothers, the direction of the attentional bias for sad faces in these two studies was opposite. One study replicated results from adults by finding evidence of preferential attention (Joormann et al., 2007), but another found evidence of attentional avoidance (Gibb et al., 2009). This discrepancy left the direction of biased attentional processing among clinically depressed youth in doubt. As such, the present study's finding that purely depressed youth, both current and lifetime, exhibit attentional biases to sad faces, consistent with the depressed adult research and one study of at-risk girls (Joormann et al., 2007), suggests that the selective attention to sad stimuli may be an important factor in depression across the lifespan.

Attentional biases to sad faces among depressed youth were observed in this study even though no mood induction or self-focus manipulation was used to prime negative cognitive processes before assessing attentional biases. Past work has suggested that such priming procedures provide more consistent evidence for cognitive vulnerabilities to depression among adults (Scher et al., 2005). Joormann and colleagues (2007) found at-risk girls attended to sad faces after a mood manipulation, whereas Gibb and colleagues (2009) found avoidance of sad faces without a mood manipulation in their at-risk child sample. Joormann and Gotlib (2007) found selective attention to sad faces without priming among remitted depressed adults. These findings, taken together with our significant results without mood priming, further reinforces the conclusion that biased attentional processing to emotionally salient stimuli is robustly associated with clinical depression. However, it may be necessary to prime negative mood to reveal significant attentional biases to sad faces among at-risk, but non-depressed, samples (e.g., see Beevers & Carver, 2003).

An important and novel set of findings is that youth with current comorbid depression and anxiety diagnoses exhibited selective attention toward both sad and angry faces, and the group of comorbid boys selectively avoided happy faces. As surprisingly little prior research has investigated attentional processing among a group of comorbid participants of any age with different emotion faces (cf. Mogg et al., 2000; see review by Bar-Haim et al., 2007), these innovative findings begin to shed important light on the role that biased processing of specific kinds of negative emotional information may play in understanding the common co-occurrence between anxiety and depression (Angold et al., 1999). Our findings are generally consistent with the two prior studies examining attention to anger among depressed adults. Specifically, whereas clinically depressed adults with elevated anxious symptoms attended to angry faces (Leyman et al., 2007), pure depressed adults do not exhibit attentional bias to angry faces (Gotlib et al., 2004). This is consistent with our finding that only comorbid youth, but not purely depressed adolescents, selectively attended to angry faces. Taken together, these

findings present a coherent picture suggesting that the attentional processing of purely depressed individuals differs from that of comorbid depressed and anxious participants and that these different diagnostic groups selectively attend to different affectively salient stimuli (i.e., sad for pure depressed, angry for pure anxious, and both sad and angry for co-occuring depressed and anxious).

These findings suggest the importance of separating purely depressed and purely anxious from comorbid depressed and anxious participants and carefully assessing for both depressive and anxiety symptoms and disorders when investigating attentional biases to emotion faces. The diagnostic status of the individuals within a particular sample may be a critical factor for understanding the specific role that attentional biases to particular affective stimuli play in elucidating risk to anxiety and depression.

Overall, therefore, this study's results are consistent with and support various theories, including models of emotion (e.g., Clark, 2005), personality factors (e.g., Mineka et al., 1998), and cognitive risk (e.g., Beck et al., 1987; Clark, Beck, & Alford, 1999; Williams et al., 1997). Each of these models posits that purely depressed youth would exhibit selective attention to sad faces only, the purely anxious youth would attend selectively to angry faces, and the comorbid group would exhibit both attentional biases to sad and angry faces.

The findings of this study should be considered in light of various strengths and limitations. Strengths include the use of a fairly large sample of children and adolescents who were interviewed for clinically significant depressive and anxiety disorders. Because the youth were recruited from the community, as opposed to psychiatric clinics, the findings are more likely to be generalizable and less prone to known problems (e.g., Berkson's bias) of clinic-based samples that can skew and distort results (e.g., Cohen & Cohen, 1984; Goodman et al., 1999). Also, by examining a sample of children and adolescents, we were able to replicate and extend findings on attentional biases with clinically depressed adults to youth with diagnoses of anxiety and depression. Given the known developmental epidemiological findings that first onsets of depression often occur in adolescence, anxiety tends to precede depression, and anxiety and depression co-occur strongly (Avenevoli et al., 2008; Costello et al., 2003; Hankin et al., 1998), studying selective attention to emotional faces as a means to understand relatively automatic cognitive vulnerabilities importantly informs a developmental psychopathological understanding of risk to depression and anxiety during this important developmental period (Cicchetti & Toth, 1998; Pine, 2007). Indeed, we found interesting and suggestive correlations between attentional biases and age of depression onset in that youth with earlier onset attended more to sad faces and avoided angry faces (see also Gibb et al., 2009), suggesting the potential importance of future research among younger samples. Finally, by examining selective attention to various emotion faces, including sad, angry, and happy relative to neutral, this study adds important information about the specificity of attentional biases to different affectively salient social cues (i.e., faces) and how these biases vary by youths' diagnostic status.

Despite these strengths, the study is limited by a cross-sectional design and relatively small sample sizes, especially for analyses that examined only currently disordered youth. As such, these findings for currently disordered youth need to be interpreted cautiously and require replication with larger samples. Future research with larger sample sizes can examine particular attentional biases of specific anxiety disorders and potential differences for current versus past disorders. Second, although the present study and prior research has shown that attentional biases to sad faces are exhibited by both currently and remitted depressed adults (Joormann & Gotlib, 2007), suggesting that these selective attention effects may not be merely a concomitant of depression, longitudinal research that tracks selective attentional biases prior to, during, and after an affective episode would illuminate more clearly the potential causal influence of these

attentional biases in the ontogeny and course of depression over time (e.g., Beevers & Carver, 2003; Gibb et al., 2009; Johnson et al., 2007). Finally, we used a relatively long stimulus presentation duration (1000 ms), as opposed to the shorter presentation duration (<500 ms) that is often used in studies investigating attentional biases in anxiety (Bar-Haim et al., 2007). This decision was made because our primary focus was on attentional biases in depression. Previous research has suggested that these biases are characterized by difficulty disengaging attention from affectively-salient stimuli, and the strongest evidence for these biases has come from studies using a 1000 ms stimulus presentation duration (for reviews, see Joormann, 2009; Mathews & MacLeod, 2005). Although we found attentional biases to anger among anxious youth even with this longer stimulus presentation, a different set of findings for attentional biases to different emotion face types may result with shorter stimulus exposure time. Future research examining selective attention in depressed and anxious individuals may benefit from use of both short, subliminal and longer, supraliminal stimulus exposure durations. Future research would also benefit from the use of eye-tracking technology, which will allow a determination of dynamic patterns of attentional allocation across an entire stimulus presentation (e.g., Caseras, Garner, Bradley, & Mogg, 2007; Garner, Mogg, & Bradley, 2006).

In sum, the current results support current models of selective attention in depression and anxiety (e.g., Williams et al., 1997). Specifically, selective attention to sad faces was associated specifically with pure depression, preferential attention to angry faces related specifically to pure anxiety, attention to both sad and angry faces was related particularly to currently comorbid depressed and anxious youth, avoidance of sad faces was observed among control youth, and comorbid boys avoided happy faces. The study of attentional biases to salient affective interpersonal stimuli, such as emotional faces, provides an important window that enables an integrative understanding of the interplay among cognitive, social, and emotional processes that may be disturbed in depression, anxiety, and the comorbidity of depression and anxiety. Understanding the specificity of biased information processing to different affectively imbued social stimuli expands knowledge on the particular cognitive processes that uniquely contribute to risk for depression, anxiety, and their co-occurrence. In conclusion, the present results, taken together with prior findings showing attentional biases to sad faces among clinically depressed adults and at-risk children (for a review, see Joormann, 2009; see also Gibb et al., 2009; Joormann et al., 2007), as well as research investigating explicit cognitive vulnerabilities predicting prospective onset of clinically significant depressive episodes among young adults (Hankin, Abramson, Miller, & Haeffel, 2004) and adolescents (Abela & Hankin, 2009; Lewinsohn, Joiner, & Seely, 2001), highlight the important role that cognitive vulnerabilities and processes play in the onset and maintenance of depression.

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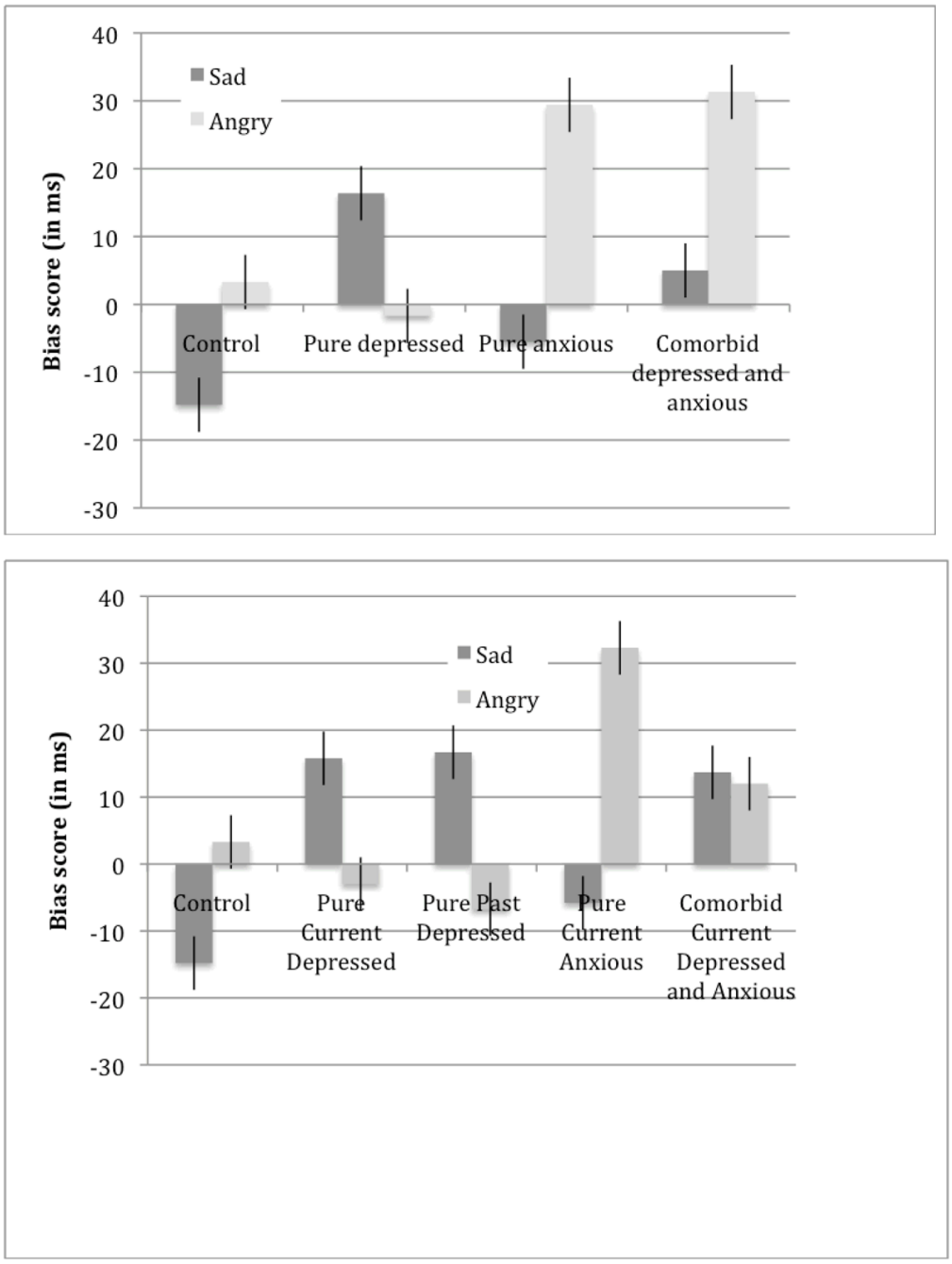

Figure 1.
Attentional bias for angry and sad faces as function of youth diagnostic groups.

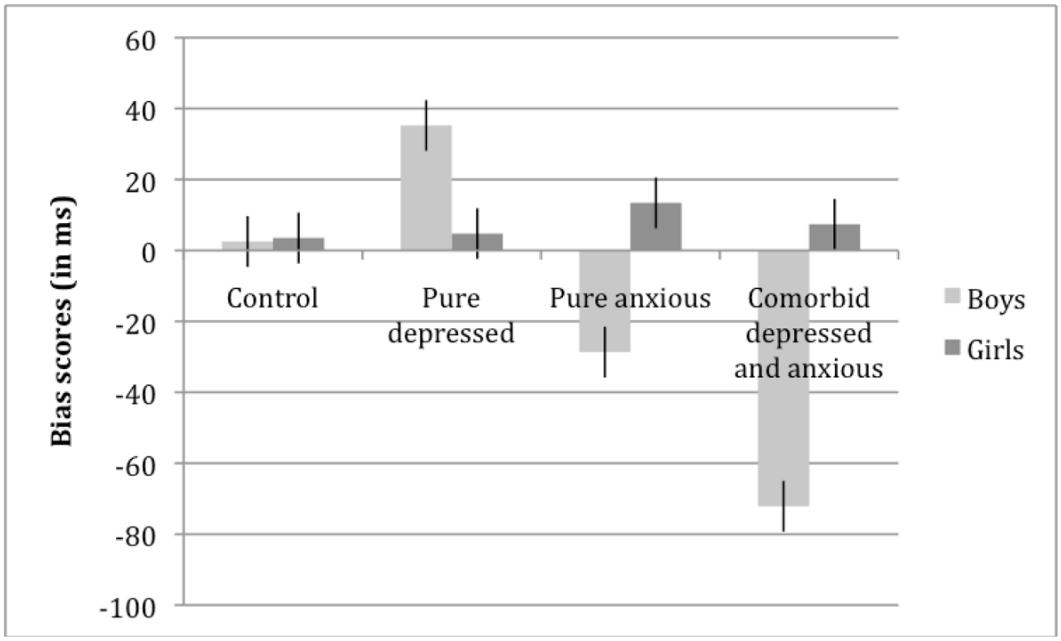

Figure 2.
Attentional bias to happy faces as a function of diagnostic group and sex

Table 1

Clinical and demographic characteristics

	Group							
	Control (N=97)		Pure Depressed (N=29)		Pure Anxious (N=21)		Comorbid (N=14)	
Characteristic	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Sex (% girls)	45%		57%		73%		64%	
Age	12.93	2.06	13.61	2.06	12.97	2.55	12.73	2.57
% Caucasian	67%		71%		100%		75%	
CDI	5.14	3.97 $_{a}$	9.35	6.95 $_{b}$	8.98	4.54 $_{b}$	11.35	4.65$_{b}$
RCMAS	11.37	5.0 $_{a}$	13.37	4.21 $_{a}$	25.30	3.8 $_{b}$	25.33	5.96 $_{b}$
MDE #	0.0	0.0 $_{a}$	1.42	.67 $_{b}$	0.0	0.0 $_{a}$	1.12	.64 $_{b}$
ANX#	0.0	0.0 $_{a}$	0.0	0.0 $_{a}$	1.57	.47 $_{b}$	1.93	.69 $_{b}$

Note: Groups with different subscripts indicate significant group differences, $p < .05$. CDI=Children's Depression Inventory. MDE#= Number of total lifetime episodes of clinical depression. ANX# = Number of total lifetime diagnoses of anxiety disorders.

Table 2

Attention bias scores to different affective facial stimuli by diagnostic group.

	Groups: Lifetime Disorders							
	Control (N=97)		Pure Depressed (N=29)		Pure Anxious (N=21)		Comorbid (N=14)	
Face Type	**M**	**SE**	**M**	**SE**	**M**	**SE**	**M**	**SE**
Angry	3.29	4.66 $_{a}$	−1.75	10.9 $_{a}$	29.42	9.33 $_{b}$	31.34	17.10 $_{b}$
Happy	−1.89	4.36 $_{a,b}$	6.07	8.93 $_{a}$	6.37	9.15 $_{a,b}$	−21.55	16.0 $_{b}$
Sad	−14.79	3.98 $_{a}$	16.38	7.57 $_{c}$	−5.53	10.04 $_{a,b}$	4.92	10.95 $_{b, c}$

	Groups: Current Disorders									
	Control (N=97)		Pure Current Depressed (N=9)		Pure Past Depressed (N=20)		Pure Current Anxious (N=15)		Comorbid Current Depressed (N=8)	
	M	**SE**	**M**	**SE**	**M**	**SE**	**M**	**SE**	**M**	**SE**
Face Type										
Angry	3.29	4.66 $_{a,b,c}$	−3.03	18.5 $_{b}$	−6.75	10.73 $_{b}$	32.29	8.59 $_{d}$	12.05	20.01 $_{a,c,d}$
Happy	−1.89	4.36 $_{a}$	10.28	6.7 $_{a}$	10.51	10.44$_{a}$	−4.59	8.12 $_{a}$	4.31	18.08 $_{a}$
Sad	−14.79	3.98 $_{a}$	15.78	13.32 $_{b}$	16.71	9.63 $_{b}$	−5.82	7.85 $_{a}$	13.7	16.68 $_{b}$

Note: Groups with different subscripts indicate significant group differences, $p < .05$.