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Gender Differences in Emotional Reactivity of Depressed and At Risk Preschoolers:

Implications for Gender Specific Manifestations of Preschool Depression

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Abstract

We investigated whether differences in positive and negative emotional reactivity could be found in depressed preschoolers and preschoolers at risk for later internalizing symptoms relative to non-depressed/low risk comparison groups. Observational measures of emotional reactivity, used to derive a score of the balance between anger and sadness, were obtained and analyzed in independent samples. One study utilized cross-sectional data from preschoolers with a current depressive syndrome and two non-depressed comparison groups. The other study utilized longitudinal data that assessed emotional reactivity at preschool age and later mental health symptoms during the transition to primary school, allowing a retrospective determination of risk. Depressed and at risk boys displayed more anger than sadness in contrast to girls in the same groups and in contrast to no disorder/low risk controls. This finding was detected in depressed and “at risk for internalizing” boys who were not comorbid for externalizing problems. The validity of these findings, which are consistent with the developmental and theoretical literature, is enhanced by their emergence in two independent samples. Results suggest possible gender specificity in the manifestations of early onset depression.

After a long history of skepticism about the possibility that children could experience clinical depression (Digdon & Gotlib, 1985; Rochlin, 1959), empirical data began to demonstrate that children and adolescents manifest symptoms of depression similar to those in the adult disorder as described in the Diagnostic and Statistical Manual (DSM; APA, 2000; Carlson & Cantwell, 1980; Puig-Antich, Blau, Marx, Greenhill, & Chamber, 1978; Ryan, Puig-Antich, & Ambrosini, 1987). Both longitudinal follow-up studies and findings of high genetic risk for affective disorders in adolescent and adult relatives of depressed child probands further emphasized the validity of depression as well as the continuity of the disorder over the lifespan (Todd, Neuman, Geller, Fox, & Hickok, 1993; Weissman et al., 1999). Studies also demonstrated that the presence of sadness and the absence of positive affective states, as evidenced by anhedonia, are primary characteristics of childhood depression (Carlson & Cantwell, 1980; Kovacs & Paulauskas, 1984). Furthermore, the unique importance of irritability or anger in childhood depression was also emphasized, leading to a developmental modification to the DSM criteria for Major Depressive Disorder (MDD) that stipulated that, in children, irritability rather than sadness can serve as a cardinal symptom of depression.

In keeping with these findings in older children, Luby and colleagues (2002;2003a) have provided data suggesting that negative emotions characteristic of adult MDD, such as sadness and anhedonia, may also arise as early as age 3. A specific and stable constellation of depressive symptoms, with associated impairment in functioning rated by both parents and teachers, was identified in these young children when core DSM symptoms were “translated” to capture their

age appropriate manifestations (Luby et al., 2002; Luby, Belden, Pautsch, Si, & Spitznagel, 2008). Sadness or irritability emerged as the most sensitive symptom among depressed preschoolers and anhedonia was the most specific. Typical symptoms of depression and vegetative signs emerged as the most robust manifestations and therefore the central identifying features of depression among young children (Luby et al., 2003a). While the diagnosis of depression was based on parent report, biological markers as well as observational evidence for the symptom of anhedonia were also detected (Luby et al., 2003b; Luby et al., 2006). These findings suggest that there may be continuity in the presence of high negative emotionality and low positive emotionality as the core manifestations of depression across the lifespan.

Beyond these basic clinical findings, few data inform our understanding of the details of how depression and its associated emotions are uniquely expressed by young children. Childhood depression is associated with high rates of co-morbidity with both internalizing and externalizing problems, a phenomenon also observed in depressed preschoolers (Angold et al., 1999; Lilienfeld, 2003; Luby et al., 2003a). However, little empirical work investigates possible differences in the emotions expressed by young children with “pure” depression and/or comorbid internalizing disorders (e.g. anxiety) vs. those with comorbid externalizing problems (e.g. ADHD etc.). Such data would contribute to an understanding of both normative emotional development and the trajectory of early onset mood disturbances.

Emotional Reactivity and Depression

In addition to clarifying the clinical manifestations of early onset depression, there is a need to identify emotional features of childhood MDD that could be detected prior to the onset of a clinical syndrome. Knowledge of depressive precursors could have great utility for early identification of children at high risk for depression, with the potential for application of preventive interventions.

In the absence of data that directly address this issue in young children, we consider three lines of evidence to inform the search for early emotional precursors of childhood depression: data on emotional precursors of adolescent or adult depression; emotional reactivity in young children at high risk for depression; and emotional reactivity in young children with a current diagnosis of depression. Although the literature on these issues is limited, some convergence of findings is apparent using the concepts of positive emotion (PE) and negative emotion (NE). All references to NE and PE that follow refer to emotional expression (as opposed to emotional experience).

Features of low PE include low levels of smiling, laughing, positive anticipation, reward seeking, energy, and contentment. Evidence reviewed by Klein, Durbin, Shankman, and Santiago (2002) indicates that PE makes a unique contribution to the prediction of depressive symptoms in both clinical and non-clinical samples of adults. Low PE, viewed as a temperamental trait, appears to be a relatively specific predisposition for depression (Clark, Watson, & Mineka 1994). This association between PE and depression has been replicated in both community and clinical adult samples (Brown, Chorpita, & Barlow 1998; Trull & Sher, 1994). Longitudinal studies also implicate low PE as a risk factor for onset of MDD later in life (Boyce et al., 1991; Clayton, Ernst, & Angst 1994; Rorsman, Grasbeck, Hagnell, Isberg, & Otterbeck 1993).

In an investigation of early markers for depression using observational ratings of emotional reactivity, preschoolers of depressed parents showed decreased rates of PE and increased rates of NE (Neff & Klein, 1992). Similar behaviors have been observed in the infants of depressed mothers (Cohn, Campbell, Matias, & Hopkins, 1990; Murray, 1992). In a long-term prospective study of a birth cohort, Caspi, Moffitt, Newman, & Silva (1996) demonstrated

continuity of PE across the lifespan and an association between low PE at age 3 years and later internalizing problems during adolescence. Low PE in a high-risk preschool sample was also associated with maternal depression (Durbin, Klein, Hayden, Buckley, & Moerk, 2005). Taken together, these findings suggest that low PE during the preschool period or earlier may be a marker of depression at later points in life. However to date there are no data available that directly links low PE early in life to the later onset of depression. Low PE is of special interest as a potential precursor of the phenomenologically similar but more severe depressive symptom of anhedonia.

The construct of NE is not the opposite of PE. Measures of NE and PE appear to be relatively independent (Watson & Tellegen, 1985). NE may manifest in internalizing (e.g., sadness) or externalizing (e.g., irritability or anger) forms. Traditionally, the conceptualization of NE includes discrete affects such as fear, sadness, anger, and disgust; as such, NE is viewed as a non-specific vulnerability to later psychopathology (Clark et al., 1994). Most relevant to depression is sadness, a withdrawal-related or internalizing negative emotion, and anger, an approach-related or externalizing negative emotion, and we view sadness and anger as the most relevant aspects of NE for childhood depression. Because the typical eliciting contexts of anger and sadness share a common feature of failure to attain a goal (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983), the relative expression of anger vs. sadness to the same incentive event or the “balance” between these two emotional reactions is of particular interest. That is, when children’s behavioral goals are blocked in some way (restraint, loss, unfair treatment, lack of expected reward), they might show an externalizing (approach-angry) or internalizing (withdrawal-sad) reaction. In this study, we quantify the balance of angry and sad reactions to the same set of standardized incentive events in two samples of young children diagnosed with, or at risk for, depression.

Gender Differences in Emotional Reactivity

Although the prevalence rates of depression do not differ in prepubertal girls versus boys (Angold & Worthman, 1993), the genders may differ in some of the discrete emotional manifestations of depression during this age period. During normative preschool development, girls show higher levels of expression of guilt, sadness and fearfulness than boys (Carter, Briggs-Gowan, Jones, & Little, 2003; Cote, Tremblay, Nagin, Zoccolillo, & Vitaro, 2002; Keenan & Shaw, 1997; Zahn-Waxler, Shirtcliff, & Marceau, 2008). Furthermore, boys often appear to be less emotionally expressive than girls, and, when boys do express emotions, they are more likely to show externalizing NE such as anger and hostility (Zahn-Waxler et al., 2008). As early as infancy, mothers have greater tolerance for, and may even actively support or encourage, displays of anger in boys but not in girls (Malatesta & Haviland, 1982). Similarly, Fivush (1991) suggests that angry expressions in toddler boys are accepted by mothers while toddler girls are encouraged to pursue more prosocial expressions. In keeping with these findings, girls smile more, are more socially sensitive and appropriate, and display more empathy and helpfulness than boys (Zahn-Waxler & Polanichka, 2004).

Similar gender differences in the expression of sadness and anger as well as the relative balance of these emotions in response to frustration in depression might constitute more extreme expressions of these prototypic, normative gender differences. Providing support for the notion that these trends will extend into the clinical domain, school age boys known to become dysthymic adolescents were more hostile and aggressive, whereas girls were described as “intropunitive” and over-controlled (Block, Gjerde, & Block., 1991). In the same sub-sample of children (who became dysthymic adolescents), girls displayed more internalized emotions while boys displayed more externalized emotions (Gjerde, 1995). Further, higher rates of sadness, crying and negative self-image were reported in depressed school age and adolescent girls compared with boys (Campbell, Byrne, & Baron, 1992; Canals, Blade, Carbajo, &

Domenech-Laberia., 2001). These gender differences evident in groups known to develop dysthymia and clinically depressed older children suggest that investigations of gender differences in the emotional manifestations of depression and/or risk states arising earlier in development during the preschool period are now warranted.

Present Study

Given the literature on childhood depression that we have reviewed, there would appear to be considerable value in the present analyses, which possess the following features: (1) Assessment of children's affect was objective, with objective scoring of affect and behavior in standardized emotion-eliciting paradigms. This feature avoids the potential biases of reports of depressed parents and retrospective interpretation of prior behavior. (2) Both a clinical sample and a community sample were employed, with clinical cases meeting modified DSM-IV criteria for depression in structured clinical interviews and at-risk children identified from the larger community sample and verified as at-risk by follow-up assessments. The relative advantages of clinical and community samples are well known, and replication across these types of samples lends additional support to the findings. (3) Comorbidity, a pervasive phenomenon in childhood disorders, is accounted for in both the clinical and the community samples. Specifically, depression that is comorbid with externalizing problems such as ADHD is distinguished from non-comorbid depression, and parallel distinctions are drawn in the community sample. In addition, both the clinical and the community sample include externalizing and low symptom groups, yielding four groups in each sample. (4) The literature reviewed above shows that child gender must be taken into account in this domain of investigation (Silk, Shaw, Skuban, Oland, & Kovacs, 2006), and we do so in the present study. (6) Finally, three affective domains are implicated in the literature: anger, sadness, and (low) pleasure. Although we analyze all three of these affective reactions, our focus was on the anger-sadness balance, which has not been previously been explicitly investigated in this literature.

Both the extant literature and a systematic approach demand that we first test whether differences in anger, sadness and joy occur as a function of diagnostic/risk group (Hypothesis 1). Specifically, the literature indicates that, under some circumstances, depressed preschoolers and those at risk should display less joy and greater sadness and anger compared with the no disorder/low risk groups. Whether depressed children who are comorbid for externalizing problems versus only depressed will differ in affective reactions is unclear from the literature. Our emphasis on the "balance" of anger and sadness was intended to provide a window into the child's emotional orientation that would not be captured by analyzing the discrete emotions. As reviewed above, anger and sadness, which frequently co-occur in children (Levine, Stein, & Liwag, 1999), can represent different responses to similar incentive events, in particular the failure to obtain goals. Thus, a balance score representing anger minus sadness should reflect the preschooler's proclivity to respond by striking back, assertion, or irritability (anger) versus withdrawal (sadness). These research questions gain specificity when gender is integrated into the prediction. Assuming that gender-specific manifestations of emotional reactivity in both depression and at-risk states are detectable during the preschool period, we also hypothesized that boys would express more anger and less sadness than girls, and that girls would express more pleasure than boys (Hypothesis 2). For the anger minus sadness balance, it follows that depressed boys would score higher than girls (Hypothesis 3).

Method

St. Louis Psychiatrically Ill Sample: Study 1

Participants—One hundred seventy four children between 3.0 and 5.6 years ($M = 4.6$) underwent a comprehensive developmental and emotional assessment at the Early Emotional Development Program at the Washington University School of Medicine as a part of a study

on the nosology of preschool depression. All study procedures were approved by the IRB and written consent was obtained from caregivers for all subjects.

Subjects were recruited from primary care settings (77% of the sample) by placing screening checklists, subsequently shown to be valid for the identification of depression (Preschool Feelings Checklist, Luby et al., 1999, unpublished checklist) in the offices' waiting rooms, and by consecutive case ascertainment (23% of the sample) from a preschool mental health clinic (Luby, Heffelfinger, Koenig-McNaught, Brown, & Spitznagel, 2004).

Three groups of children were recruited for participation in the study using a telephone interview conducted by a trained research assistant: 1) those with two or more symptoms of depression, 2) those with two or more symptoms of externalizing psychiatric disorders (ADHD and/or ODD), and 3) those with no psychiatric symptoms. Following the telephone screen to determine eligibility for the study, diagnostic status was determined by parent report (92% mothers) on the Diagnostic Interview Schedule for Children Version IV- Young Child (DISC-IV-YC, Lucas, Fisher, & Luby, 1998).

For the present study, 156 children ($n = 75$ boys, $n = 81$ girls) were categorized into one of four groups: (1) those who met DSM-IV criteria for major depressive disorder (MDD), with or without other internalizing disorders but without any externalizing disorder, were included in the "pure" depressed/internalizing group, *MDD/INT ONLY* ($n = 8$ boys, $n = 9$ girls); (2) those who met DSM-IV criteria for ADHD and/or ODD, but did not meet criteria for any internalizing disorder, were included in the "pure" externalizing group, *ADHD/ODD* ($n = 25$ boys, $n = 20$ girls); (3) those who met DSM-IV criteria for both MDD and ADHD/ODD were included in the comorbid group, *MDD/EXT* ($n = 16$ boys, $n = 21$ girls); and (4) those who did not meet criteria for any psychiatric disorder were included in the healthy (i.e., no disorder) control group, *CON* ($n = 26$ boys, $n = 31$ girls).

The sample was predominantly Caucasian (85.9%), married (82.5%), and middle class, with annual family incomes greater than \$60,000 and over half of mothers (58.5%) and fathers (55.6%) with a college education. The ages of the children were approximately equally divided between 3, 4, and 5 year-olds (28.2%, 35.9%, and 35.9%, respectively). Chi-square analyses revealed no significant differences in age by diagnostic group; and one way analysis of variance (ANOVA) followed by Scheffe post hoc tests revealed no significant differences in age by emotional reactivity (NE and PE) with the one exception ($p = .03$) that 4 year-olds had lower PE scores ($M = -0.086$, $SE = 0.047$) than 5 year-olds ($M = 0.085$, $SE = 0.049$).

Measures

Emotional Reactivity: Emotional reactivity of the three discrete emotions of joy, sadness and anger was assessed with the Laboratory Temperament Assessment Battery (Lab-TAB), an observational measure designed specifically for preschool children (Goldsmith, Reilly, & Lemery, 1995; Goldsmith, Lemery, & Essex, 2004). Lab-TAB was administered in a standardized fashion in a laboratory setting as a part of a comprehensive research assessment. Children were videotaped while responding to scripted, structured "incentive events," with an examiner present. These incentive events, or episodes were selected to elicit joy (high-level positive affect) or sadness and/or anger. Seven Lab-TAB episodes, each lasting 1-5 minutes, were administered at specified times during a 2-3 hour assessment. Three episodes were designed to elicit positive affective responses of joy, and four episodes tapped negative affective responses of sadness and/or anger. A transition/recovery period followed each episode to allow affective resolution and return to the child's emotional baseline before the next task. The time needed for recovery was based on the judgment of a trained examiner, and extra time was seldom needed. Lab-TAB episodes were presented in the same order for all subjects so that any order effects would be constant across individuals.

Table 1 describes the episodes used in each study, and the facial, bodily, and vocal behaviors coded in episodes designed to elicit joy or sadness and/or anger. To assure the objectivity of these behavioral measures, coding was done using manualized guidelines within 10-second intervals (with the exception of the Popping Bubbles episode, which was coded within 3 intervals, each defined by a trial beginning with the research assistant blowing the bubbles and ending when the bubbles were fully dissipated). Guidelines outlined by Goldsmith and colleagues (1995) were used to code all tapes, and all raters underwent specific training to ensure high inter-rater reliability. A mean inter-rater reliability Cohen's kappa statistic was calculated for the coding of all behaviors in each episode; and the average of the kappas across the 7 episodes was .86. All coding was done by raters blind to the diagnostic status of the subjects.

Within each episode, the within-interval scores for each behavioral response (e.g., within the Box Empty episode, intensity of facial sadness was coded in six 10-second intervals) were then used to derive scores representing three dimensions of that response: latency to response (i.e., time, in seconds, from beginning of episode to first expression of behavior being coded), peak intensity of response (i.e., highest score given to behavior being coded across all intervals in the episode), and mean intensity of response (i.e., average score given to behavior being coded across all intervals in the episode, with the exception of the dichotomous behavioral response of laughter, which was scored as the percent of intervals in which it was present). This resulted in six Lab-TAB scores for episodes eliciting joy (i.e., latency, peak, and mean scores for smiling and laughter), and 15 Lab-TAB scores for episodes eliciting sadness and/or anger (i.e., latency, peak, and mean scores for facial sadness, bodily sadness, facial anger, bodily anger, and frustration/protest). All scores were standardized into z-scores.

Next, in keeping with standard and widely used psychometric principles, we used a two-pronged approach to guide the combination of the latency, peak, and mean behavioral scores into composite variables of joy, sadness, and anger within each episode (i.e., "narrow band" behavior composites). The behavioral scores within each episode were examined for covariation (primarily using correlations and principal components analysis), taking into consideration that the decision to combine variables within episodes eliciting sadness and/or anger also required that they were conceptually related. For example, if Facial Sadness was correlated with both Bodily Sadness and Facial Anger, the Facial Sadness and Bodily Sadness variables would be combined to create a "narrow band" composite "Sadness" variable, but Facial Sadness and Facial Anger would not be combined due to the lack of a conceptual relationship. With only minor exceptions, this resulted in a "narrow band" composite of Joy (assessed in each of three episodes), including the latency, peak, and mean scores for smiling and laughter (i.e., 6 component items); a "narrow band" composite of Sadness (assessed in each of four episodes), including the latency, peak, and mean scores for facial and bodily sadness (i.e., 6 component items); and a "narrow band" composite of Anger (assessed in the same four episodes as Sadness), including the latency, peak, and mean scores for facial and bodily anger, and frustration/protest (i.e., 9 component items). The resulting eleven "narrow band" composites were each constructed by taking the mean of the identified variables; all alpha coefficients > .70.

Finally, following the same approach, for each discrete emotion (joy, sadness, anger), the "narrow band" composites were examined for covariation across episodes, and then composited by taking their mean. This resulted in the three "broad band" affective factors of primary interest: *Joy*, *Sadness*, and *Anger*; compared with the narrower composites, the reliability of these broader composites was somewhat lower, as expected, all alpha coefficients > .55.

In addition, and perhaps of greatest importance, a score for the *Balance of Sadness and Anger* was constructed as the difference between the two broad band scores (Anger minus Sadness). In the context of this study, the expression of anger and sadness are best viewed jointly rather than independently. Lab-TAB episodes yield both anger and sadness measures obtained from sequential coding in a child's stream of behavior. A child might become sad and resigned after first expressing anger and frustration in a particular Lab-TAB episode, or a child might react predominantly angrily in one episode but with sadness in another. Thus, the balance of anger and sadness across all episodes would seem to be an efficient indicator of externalizing versus internalizing (or approach versus avoidance) orientations to provocations.

Wisconsin Community Sample: Study 2

Participants—Preschoolers in this sample were participants in the Wisconsin Study of Families and Work (Essex, Klein, Miech, & Smider, 2001), an ongoing longitudinal study of child development. All study procedures were approved by the IRB and written consent was obtained from caregivers for all subjects. Parents were recruited during mother's second-trimester of pregnancy from obstetric clinics in and around Madison and Milwaukee, Wisconsin (see Hyde, Klein, Essex, 1995, for additional details). Of the 762 women who met inclusion criteria, 192 (25%) refused to participate. Participants and non-participants differed significantly on only two of the demographic variables collected at the initial screening: participants had significantly more years of education ($M = 15.0$, $SD = 2.2$) than non-participants ($M = 14.6$, $SD = 2.2$; $t(742) = 2.26$, $p = .02$), while family income was lower for participants (in thousands, $M = \$47.8$, $SD = \$23.2$) than non-participants ($M = \$53.7$, $SD = \$35.4$; $t(721) = 2.00$, $p = .05$). There were no differences between the two groups on mother's age, race/ethnicity, or mothers' or fathers' current work status.

The sample ($n=570$) was predominantly Caucasian (89.8%) and middle class (annual family income $M = \$49,902$, $SD = \$22,692$; 54% of mothers and 48% of fathers had a college education); 42% were first-time mothers; 95% were married. When the children were age 4.5 years, only those families still living within geographic proximity of the project offices were asked to participate in the Lab-TAB assessments. The resulting sample of 403 families ($n = 197$ boys; $n = 206$ girls) in the present study are those who participated in the Lab-TAB assessments and whose mothers and teachers provided data on the children's mental health symptoms during the kindergarten and first grade years. With one exception, there were no differences in any demographic variable between these families and the remaining 167 families of the original sample; 42% of the participating mothers versus 32% of the non-participating mothers were first-time mothers ($\chi^2 = 4.57$, $p = .038$). Because a portion of the participating children exhibited high levels of mental health symptoms at first grade, this sub-group is referred to as an "at risk" group.

Diagnostic Status: The Diagnostic Interview Schedule for Children Version IV-Young Child (DISC-IV-YC; Lucas et al., 1998), a fully structured psychiatric interview, was used to determine diagnostic status in the sample. The DISC-IV-YC is a version of the well-validated DISC-IV (Schaffer, Fisher, & Lucas, 1998) modified for young children in specific diagnostic modules to account for the age-appropriate developmental manifestations of symptom states (see Luby et al., 2003b, for a complete description). For all disorders investigated, all formal DSM-IV diagnostic criteria were applied with the exception of the duration criteria for MDD, which were set aside due to ambiguity in their application to this age group (see Luby et al., 2002, for a detailed description).

In the absence of categorical DSM-IV diagnoses as in Study 1, children in the Wisconsin sample were grouped based on dimensional mother and teacher reports of children's mental health symptoms assessed during the transition to primary school (spring of kindergarten and

first grade), approximately 1–2 years after the assessment of emotional reactivity. Internalizing and externalizing symptoms were assessed using the MacArthur Health and Behavior Questionnaire (HBQ; Armstrong, Goldstein, The MacArthur Working Group on Outcome Assessment 2003; Boyce et al., 2002; Essex et al., 2002). For each informant, scores for Internalizing Symptoms and Externalizing Symptoms were computed as the mean of the constituent subscales. The subscales for Internalizing Symptoms included Depression, Over-Anxiousness, and Separation Anxiety (for mothers only); subscales for Externalizing Symptoms included Oppositional Defiance, Conduct Problems, Overt Aggression, Relational Aggression, and Inattention/Impulsivity. All HBQ items were scored on 3-point scales (0 = Never or not true; 1 = Sometimes or somewhat true; 2 = Often or very true). Demonstrations of the validity and reliability of these measures have been reported elsewhere (Ablow et al., 1999; Essex et al., 2002; Luby et al., 2002). In the present sample, α coefficients for mothers and teachers exceeded .80 for both Internalizing Symptoms and Externalizing Symptoms at each of the two assessments. Correlations of each informant's reports across kindergarten and first grade were high ($> .60$) and thus were averaged to increase the reliability of the assessment of symptoms during the school transition. Mother and teacher reports, which were significantly correlated (internalizing $r = .27$, externalizing $r = .50$; $ps < .01$), were then averaged to take account of the young child's behavior across contexts.

Preschoolers were categorized into four groups based on these scores for later Internalizing and Externalizing Symptoms during the school transition. These groups, which parallel the groups in Study 1, will henceforth be referred to as "risk groups." In order to obtain groups of sufficient size for the proposed analyses, upper 25% cut-points on Internalizing Symptoms (cut-point = 0.39; range = 0 - 0.97) and Externalizing Symptoms (cut-point = .51; range = 0 - 1.30) were used. In an independent multi-site case-control study of children ages 4 – 7 years, HBQ cut-points of .54 for Internalizing Symptoms and .64 for Externalizing Symptoms distinguished clinic-referred from community controls (Ablow et al., 1999); these cut-points correspond to the upper 10% and 13%, respectively, of the children in Study 2. The four resulting groups of children include: (1) those in the upper 25% on Internalizing Symptoms and lower 75% on Externalizing Symptoms, defined as the "pure" internalizing group, *INT ONLY* ($n = 20$ boys, $n = 41$ girls); (2) those in the upper 25% on Externalizing Symptoms and the lower 75% on Internalizing Symptoms, defined as the "pure" externalizing group, *EXT* ($n = 51$ boys, $n = 15$ girls); (3) those in the upper 25% on both Internalizing and Externalizing symptoms, defined as the comorbid group, *INT/EXT* ($n = 24$ boys, $n = 24$ girls); and (4) those in the lower 75% on both Internalizing and Externalizing Symptoms, defined as the healthy (i.e., low symptoms) control group, *CON* ($n = 102$ boys, $n = 126$ girls).

Method

Emotional Reactivity: As in Study 1, emotional reactivity was measured at preschool age (4.5 years) using Lab-TAB (Goldsmith et al., 1995; 2004). As part of a more extensive two-hour assessment in participants' homes, 12 Lab-TAB episodes were administered in a standardized order preceded and followed by other assessments. Five of the episodes tapped constructs of interest here, and four of them were identical to the episodes used in Study 1 (see Table 1). However, compared to Study 1, there was one less episode focused on joy. Coding procedures were the same as those described above for Study 1, with Cohen's kappa (calculated for the coding of all behaviors in each episode) averaging .93 across all five episodes. The same procedures as described above for Study 1 were also used to construct measures of Joy, Sadness, Anger and the Balance of Sadness and Anger. The resulting eight "narrow band" behavioral composites (i.e., Joy assessed in two episodes; Sadness and Anger each assessed in three episodes) all showed alpha coefficients $> .80$; and the final "broad band" composites for Joy, Sadness, and Anger all showed alpha coefficients $> .56$.

Results

Descriptive statistics for the four emotional reactivity variables (Joy, Sadness, Anger, and the Balance of Sadness and Anger) are presented in Table 2. For each sample, two-way analyses of variance (ANOVA) with four diagnostic/risk groups and gender were conducted separately for each emotional reactivity variable. Initial analyses focused on the three discrete emotions elicited in the Lab-TAB tasks. The primary analyses focused on the Balance of Sadness and Anger. Where significant overall main effects are reported, formal post hoc tests with Bonferroni corrections and adjusted p-values are presented. Interactions of diagnostic/symptom group with gender were also investigated. Due to the exploratory nature of some of these analyses, coupled with the recognized difficulty of identifying interactions (see review of Zahn-Waxler, Klimes-Dougan, & Slattery, 2000), we relied on independent sample t-tests for probing significant interactions and on the strategy of replication across the two studies.

Discrete Emotions of Reactive Joy, Sadness, and Anger

The results of the initial six analyses (three for each sample) of the discrete emotions provided only limited support for the hypotheses that we derived from the literature. The ANOVAs with Joy and Sadness as the dependent variables yielded no significant main or interaction effects for either sample. The ANOVAs with Anger as the dependent variable yielded significant effects only for the Wisconsin sample, which showed significant main effects for symptom group [$F(3,395) = 6.45, p < .001$] and gender [$F(1,395) = 11.39, p = .001$]. Supporting Hypothesis 1, pairwise comparisons of symptom group means showed that children with high levels of comorbid internalizing/externalizing symptoms (INT/EXT $M = .30, SE = .07$) displayed more reactive anger than children with either low symptoms (CON $M = -.05, SE = .03; p < .001$) or pure internalizing symptoms (INT ONLY $M = .08, SE = .07; p = .009$). No pairwise comparisons were significant for children with high levels of externalizing symptoms only (EXT $M = .05, SE = .08$).

Supporting Hypothesis 2, boys in the Wisconsin sample ($M = .21, SE = .05$) displayed more reactive anger than girls ($M = -.02, SE = .05$). There was also a significant interaction of gender with symptom group [$F(3,395) = 3.35, p = .019$], showing that boys with high levels of pure internalizing symptoms (INT ONLY $M = .36, SE = .12$) displayed significantly higher levels of reactive anger than girls with high levels of pure internalizing symptoms (INT ONLY $M = -.21, SE = .08; t(59) = 4.84, p < .001$). There were no gender differences within the other three symptom groups (INT/EXT boys $M = .37, SE = .11$, girls $M = .23, SE = .11$; EXT boys $M = .11, SE = .07$, girls $M = .003, SE = .13$; CON boys $M = -.02, SE = .05$, girls $M = -.09, SE = .05$).

The Balance of Sadness and Anger

The results of the analyses focused on the Balance of Sadness and Anger (Hypothesis 3) further clarified the associations of gender, diagnostic/symptom group, and negative emotional reactivity. In both samples, there was a significant main effect of gender [Wisconsin $F(1,395) = 9.20, p = .003$; St. Louis $F(1,148) = 4.06, p = .046$], with boys displaying relatively greater reactive anger than sadness (Wisconsin $M = .26, SE = .06$; St. Louis $M = .08, SE = .04$) and girls displaying a more balanced mix or a slight predominance of reactive sadness (Wisconsin $M = -.005, SE = .06$; St. Louis $M = -.03, SE = .04$). In the Wisconsin sample only, there was also a significant main effect of symptom group, $F(3,395) = 6.16, p < .001$, with pairwise comparisons of group means showing that children in the comorbid INT/EXT ($M = .34, SE = .10$) and EXT only ($M = .14, SE = .10$) groups displayed relatively more anger than sadness compared with children in the low symptom group (CON $M = -.09, SE = .05; p = .001$ and $p = .032$, respectively). Most importantly, the gender by diagnostic/symptom group interaction was significant in both samples [Wisconsin $F(3,395) = 3.15, p = .025$; St. Louis $F(3,148) = 2.99, p = .033$]. These interactions, which are illustrated in Figures 1a and 1b, highlight the

finding that it is within the “pure” depressed/internalizing groups where boys (Wisconsin $M = .47$, $SE = .15$; St. Louis $M = .25$, $SE = .12$) display a greater predominance of reactive anger whereas girls display a greater predominance of reactive sadness (Wisconsin $M = -.22$, $SE = .11$; St. Louis $M = -.21$, $SE = .11$; $t(59) = 3.87$, $p < .001$ and $t(15) = 3.13$, $p = .007$, respectively). No gender differences emerged within the other three diagnostic/symptom groups in either the Wisconsin sample (INT/EXT boys $M = .43$, $SE = .14$, girls $M = .24$, $SE = .14$; EXT boys $M = .21$, $SE = .10$, girls $M = .06$, $SE = .18$; CON boys $M = -.07$, $SE = .07$, girls $M = -.11$, $SE = .06$) or the St. Louis sample (MDD/EXT boys $M = .10$, $SE = .08$, girls $M = -.02$, $SE = .07$; ADHD/ODD boys $M = .03$, $SE = .07$, girls $M = .09$, $SE = .07$; CON boys $M = -.03$, $SE = .06$, girls $M = .001$, $SE = .06$).

Discussion

Interpretation of Key Findings

Because the issues addressed in this study are relatively novel, and because the use of direct observational assessment of young children’s emotional reactivity—while gaining interest—has not yet become a standard research method in child psychiatry, we depended on the convergence of results from two independent studies for drawing inferences. We focused primarily on findings that were significant in both samples and less on findings that emerged only in the larger Wisconsin sample. Results that were consistent despite differences in sample type (clinical vs. community risk) and psychopathology assessment method (clinical diagnosis using a structured interview vs. an average of parent and teacher report using a dimensional questionnaire) should be more readily generalized to other samples than most results from single studies.

The strongest convergence of results from the two samples occurred when scores representing the relative balance between anger and sadness were analyzed; these were the analyses associated with Hypothesis 3. The key finding from this investigation, portrayed in Figures 1a and 1b, was that boys within the “pure” depressed/internalizing groups showed a predominance of reactive anger whereas girls showed a predominance of reactive sadness. The effect size of this difference was large in both samples (Wisconsin, $d = .95$; St. Louis, $d = 1.22$). As described above, anger and sadness represent contrasting and consequential responses to the experience of failure to obtain a desired goal. Anger and sadness are scored from the same Lab-TAB episodes; they preempt one another in a child’s discrete reaction to the stimuli, but they may be coded sequentially in a child’s stream of behavior. For these reasons, we hypothesized that the balance of anger relative to sadness would be of unique importance in characterizing emotional reactivity. We note the prominent role of depression itself rather than co-morbid externalizing symptoms in our key finding; it was the “pure” depressed group rather than the mixed comorbid group that showed the replicated gender difference in the Balance of Sadness and Anger, and this occurred despite the small size of the “pure” depressed group in the St. Louis sample. This is of clinical importance as anger is a known feature of many externalizing disorders, while it is not generally acknowledged as a clinical symptom of depression and/or internalizing psychopathology.

The developmental literature is generally consistent with our observation of replicated main effects of gender on the Balance of Anger and Sadness. Boys greater relative anger expression in the Lab-TAB episodes is consistent with higher rates of negative affect shown by boys and higher levels of social monitoring shown by girls during social disappointment tasks in a normative population (Davis, 1995).

Also notable among our results was the absence of the expected diagnostic group differences in low PE (e.g., depressed/risk group showing less joy than controls) in our samples, in contrast to the high-risk sample reported by Durbin and colleagues (2005). The Durbin et al. high-risk

sample was composed of preschoolers with depressed mothers in contrast to our samples, which were identified only on the basis of the child's behavior. The difference in how the samples were identified might have resulted in the Durbin et al's sample being enriched for both genetic risk and attenuated maternal responsivity, as compared with ours. Furthermore, differences in the specific Lab-TAB episodes used as well as procedural differences (e.g. the Durbin et al. report had mother's present in the room during Lab-TAB while mother was not present in these investigations) might also have contributed to the apparent discrepancy in findings. Especially given our limited power to reveal effects of low PE in the clinical (St. Louis) sample, we continue to regard the developmental association of low PE with childhood depression as important and worthy of more research attention.

While this study was not designed to address possible etiologies of these gender differences in emotional reactivity, the developmental psychology literature provides pertinent theory and empirical data for speculation (Cole, Michel, & Teti, 1994; Weinberg, Tronick, Coh, & Olson, 1999; Zahn-Waxler et al., 2008). Along these lines, theory and some empirical investigations have suggested that boys may be less likely to manifest depression directly but rather tend to displace underlying feelings of sadness into anger, a dynamic validated by the high rates of externalizing symptoms demonstrated in depressed boys (Gjerde & Block, 1996; Kovacs, Obrosky, & Sherrill, 2003; Zahn-Waxler, Crick, Shirtcliff & Woods, 2006). Such a pattern of emotional reactivity could be influenced by the greater social acceptability of the expression of anger in boys and decreased acceptability of the expression of sadness.

The emotionally evocative events used to elicit anger/sadness in Lab-TAB have both loss (e.g. inability to obtain a desired prize) and "thwarting of action" (failure to successfully break through a barrier to obtain desired object) components. Another possible explanation for the gender differences observed is that boys were more attuned/reactive to the experience of being thwarted while girls were more attuned/reactive to the loss experience. This explanation would imply gender differences in how boys and girls experienced the Lab-TAB stimuli and accordingly how they might experience similar kinds of mildly negative life experiences in daily life.

It is important to emphasize that the emotions as investigated were not measures of spontaneous emotion but rather emotional reactivity in response to an incentive event designed to induce the specific emotional response. In that sense, anger and sadness as investigated in these studies could best be described as elicited or reactive emotions. Keeping this in mind helps specify the nature of the differing forms of emotional reactivity that were observed.

Limitations

Some findings emerged in one sample and not the other. This may be partly due to differences in the design of these two independent studies, which differed mainly in (1) the exact set of Lab-TAB episodes used; (2) how symptoms were characterized and whether formal diagnoses were made; and (3) sample size, with the Wisconsin study having greater statistical power. The small size of the St. Louis study, especially for pursuing interactions of gender and diagnostic group, and questions regarding preschoolers with depression only, necessitated the partially exploratory nature of the investigation and its primary emphasis on replication of findings as the basis for inference. In addition, because mental health symptoms of the Wisconsin sample were not obtained at the preschool assessment, it is not possible to sort out definitively whether the findings regarding differences in the preschoolers' emotional reactivity reflect precursors to later internalizing/externalizing symptoms or whether the children with elevated symptoms at follow-up already evidenced elevated symptoms at the preschool assessment. The relative ethnic and socio-economic homogeneity of both samples was also a limitation of the study.

Implications for Policy, Research, and Practice

The most striking finding from this investigation was the emergence of gender differences in patterns of emotional reactivity among depressed and at risk preschoolers. Anger (externalizing NE) rather than sadness (internalizing NE) was found to be a more predominant feature among depressed and at risk preschool boys, while sadness was a more predominant feature of depressed/at risk girls. These gender differences in the balance of sadness and anger emerging in two independent and qualitatively different samples strongly supports the need for further investigation of this finding in diverse samples. If replicated, the findings invite clinical consideration of a gender specific nosology for childhood depressive disorders. This finding could have very important clinical implications as the decreased expression of sadness and the salience of anger increase the risk that young boys would be labeled as disruptive rather than depressed by caregivers or clinicians based on the current nosology. Greater attention to this possible gender specificity in clinical assessments might enhance the clinician's ability to identify depression in young boys.

While the presence of anger in depressive states has been described in the developmental literature, and the related symptom of irritability has been recognized as a childhood-specific marker of depression in the DSM nosology, the emotion of anger itself has not generally been regarded as a central clinical feature of childhood depression. Anger is more commonly conceptualized as a marker of externalizing disorders of childhood such as Oppositional Defiant Disorder (ODD) or Conduct Disorder. While the presence of anger in externalizing disorders has face validity, the salience of anger in depression is an under-recognized feature of the disorder. The expectation that depressed preschoolers would react with increased sadness to a sad inducing event because of an increased vulnerability for and predominance of sad affect has greater face validity and as such is consistent with the recognized clinical features of this disorder.

These findings are the first to our knowledge demonstrating fundamental gender differences in the manifestation of depression and related internalizing risk states in young children and more generally objective alterations in emotional expression in early psychopathological states. These findings have implications for the importance of assessing emotional development per se in the identification of psychopathology and high-risk states. Along these lines, findings also suggest that the trajectory of emotional development itself may be altered as a result of early onset psychopathology and risk states. Longitudinal investigations of the relationship between these aspects of emotional development and acute, remitted or chronic psychopathology are now warranted.

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Figure 1.**Wisconsin Sample**

The Balance of Sadness versus Anger (Anger minus Sadness) in four diagnostic/symptom groups of children from two independent samples. Symptom groups in the Wisconsin sample (Figure 1) include children in the upper 25% of the distribution of internalizing symptoms only (INT ONLY; boys $n = 20$, girls $n = 41$), children in the upper 25% of the distribution of externalizing symptoms only (EXT; boys $n = 51$, girls $n = 15$), children in the upper 25% of the distributions of both internalizing and externalizing symptoms (INT/EXT; boys $n = 24$, girls $n = 24$), and children in the lower 75% of the distributions of internalizing and externalizing symptoms (CON; boys $n = 102$, girls $n = 126$).

Figure 2.

St. Louis Sample

Diagnostic groups in the St. Louis sample include preschoolers who met DSM-IV MDD criteria [except duration criteria “set aside” (MDD/INT ONLY), with or without other internalizing disorders, only; boys $n = 8$, girls $n = 9$), preschoolers who met DSM-IV criteria for ADHD and/or ODD only (ADHD/ODD; boys $n = 25$, girls $n = 20$), preschoolers who met DSM-IV criteria for both MDD/internalizing and ADHD/ODD (MDD/EXT; boys $n = 16$, girls $n = 21$), and those who did not meet criteria for any DSM-IV disorder (CON; boys $n = 26$, girls $n = 31$).

Table 1

Descriptions of Lab-TAB Episodes For Eliciting Joy and Sadness/Anger

Episode Name	Description	St. Louis Sample	Wisconsin Sample
<i>To Elicit Joy^a</i>			
(1) Pop-Up Snake	Child opens can presumably filled with snack and spring loaded toy snakes pop out. Child then anticipates surprising parent with this toy.	X	X
(2) Popping Bubbles	Examiner blows soap bubbles; child pops them with hands, feet, elbows.	X	X
(3) Make that Car Go	Child and examiner play with toy cars on a racetrack.	X	<i>Not used</i>
<i>To Elicit Sadness/Anger^b</i>			
(4) End of the Line	Examiner demonstrates an attractive toy, allows child to play with it, then abruptly takes it away from child.	<i>Not used</i>	X
(5) Transparent Box	Attractive toy is locked in a transparent box that child cannot open.	X	X
(6) Not Sharing	Examiner takes more desirable candy than gives to child, leaving child with little.	X	<i>Not used</i>
(7) Box Empty	Child opens attractively wrapped gift expecting a toy and finds box empty.	X	X
(8) No Stickers Left	Child promised a preferred sticker and then told that none are left and will have to take undesirable sticker.	X	<i>Not used</i>

^aCoded for 2 behaviors: intensity of smiling and presence/absence of laughter.

^bCoded for 5 behaviors: intensity of facial and bodily sadness, facial and bodily anger, and frustration/protest.

Table 2

Descriptive Statistics by Gender and Diagnostic/Risk Group

	Girls				Boys			
	MDD/ Internalizing Only	Co-morbid Internalizing/ Externalizing	Externalizing Only	Healthy Controls	MDD/ Internalizing Only	Co-morbid Internalizing/ Externalizing	Externalizing Only	Healthy Controls
	M (SD) Range	M (SD) Range	M (SD) Range	M (SD) Range	M (SD) Range	M (SD) Range	M (SD) Range	M (SD) Range
St. Louis: Study 1	<i>n</i> = 9	<i>n</i> = 21	<i>n</i> = 20	<i>n</i> = 31	<i>n</i> = 8	<i>n</i> = 16	<i>n</i> = 25	<i>n</i> = 26
Anger	-.117 (.142) -0.28 – 0.20	-.024 (.257) -0.41 – 0.82	.050 (.279) -0.33 – 0.78	.021 (.308) -0.56 – 0.69	.070 (.166) -0.16 – 0.28	-.032 (.182) -0.28 – 0.24	.063 (.310) -0.49 – 1.08	-.007 (.244) -0.32 – 0.52
Sadness	.089 (.367) -0.41 – 0.66	-.006 (.263) -0.37 – 0.63	-.038 (.218) -0.44 – 0.24	.019 (.311) -0.70 – 0.62	-.179 (.112) -0.33 – -0.03	-.128 (.267) -0.47 – 0.58	.037 (.319) -0.66 – 0.81	.026 (.278) -0.45 – 0.56
Joy	-.090 (.275) -0.66 – 0.18	.108 (.377) -0.42 – 0.77	.144 (.265) -0.54 – 0.55	-.036 (.463) -1.18 – 0.76	-.059 (.437) -0.60 – 0.77	.021 (.261) -0.49 – 0.61	-.152 (.348) -0.82 – 0.60	-.105 (.182) -0.52 – 0.21
Balance (Anger — Sadness)	-.206 (.355) -0.74 – 0.34	-.018 (.190) -0.43 – 0.27	.087 (.362) -0.31 – 1.14	.002 (.395) -0.85 – 0.78	.249 (.218) -0.11 – 0.50	.095 (.260) -0.41 – 0.63	.026 (.295) -0.75 – 0.50	-.033 (.382) -0.71 – 0.67
Wisconsin: Study 2	<i>n</i> = 41	<i>n</i> = 24	<i>n</i> = 15	<i>n</i> = 126	<i>n</i> = 20	<i>n</i> = 24	<i>n</i> = 51	<i>n</i> = 102
Anger	-.209 (.435) -0.80 – 0.85	.228 (.480) -0.91 – 0.99	.003 (.604) -0.88 – 1.27	-.094 (.495) -0.92 – 1.22	.361 (.424) -0.37 – 1.33	.367 (.599) -0.69 – 1.35	.105 (.612) -0.88 – 1.51	-.015 (.509) -0.88 – 1.37
Sadness	.005 (.540) -0.83 – 1.26	-.015 (.489) -1.00 – 0.82	-.060 (.453) -0.90 – 0.68	.016 (.503) -1.22 – 1.35	-.108 (.467) -0.77 – 0.84	-.065 (.474) -1.19 – 0.81	-.107 (.509) -1.15 – 0.96	.052 (.528) -1.51 – 1.28
Joy	-.052 (.532) -1.37 – 1.05	.147 (.472) -0.75 – 0.88	.185 (.612) -0.83 – 1.08	-.078 (.558) -1.82 – 1.28	.162 (.318) -0.39 – 0.63	-.091 (.537) -1.18 – 0.85	.118 (.494) -1.22 – 1.26	-.041 (.510) -1.65 – 1.22
Balance (Anger — Sadness)	-.215 (.666) -1.74 – 1.14	.243 (.635) -0.83 – 1.99	.063 (.782) -1.35 – 1.13	-.110 (.656) -1.79 – 1.39	.469 (.608) -0.82 – 1.74	-.432 (.728) -0.67 – 2.54	.212 (.757) -1.67 – 2.56	-.066 (.698) -1.56 – 1.58