

2 **Positive Emotion Specificity and Mood Symptoms**
3 **in an Adolescent Outpatient Sample**

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8 **Abstract** Research on positive emotion disturbance has
9 gained increasing attention, yet it is not clear which
10 specific positive emotions are affected by mood symptoms,
11 particularly during the critical period of adolescence. This
12 is especially pertinent for identifying potential endophe-
13 notypic markers associated with mood disorder onset and
14 **AQ1** course. The present study examined self-reported discrete
15 positive and negative emotions in association with clini-
16 cian-rated manic and depressive mood symptoms in a
17 clinically and demographically diverse group of 401 out-
18 patient adolescents between 11 and 18 years of age.
19 Results indicated that higher self reported joy and contempt
20 were associated with increased symptoms of mania, after
21 controlling for symptoms of depression. Low levels of joy
22 and high sadness uniquely predicted symptoms of depres-
23 sion, after controlling for symptoms of mania. Results were
24 independent of age, ethnicity, gender and bipolar diagnosis.
25 These findings extend work on specific emotions impli-
26 cated in mood pathology in adulthood, and provide insights

into associations between emotions associated with goal 27
driven behavior with manic and depressive mood symptom 28
severity in adolescence. In particular, joy was the only 29
emotion associated with both depressive and manic 30
symptoms across adolescent psychopathology, highlighting 31
the importance of understanding positive emotion distur- 32
bance during adolescent development. 34

Keywords Positive emotion · Mania · Depression · 35
Adolescence 36

Introduction 37

Bipolar spectrum disorders (referred to as BPSD) involve 38
severe and recurring mood symptomatology, affecting up 39
to 4 % of the general population over the course of a 40
lifetime (e.g., Kessler et al. 2005) and roughly 2 % of 41
adolescents world-wide (Van Meter et al. 2011). Severe **AQ2** 42
mood symptoms include both *manic* symptoms associated 43
with heightened and persistent elevated mood and 44
increased reward seeking and goal pursuit, and *depressive* 45
symptoms associated with depressed mood and decreased 46
reward seeking and goal pursuit. Importantly, severe mood **AQ3** 47
disturbance is ranked among the top ten causes of medical 48
disability worldwide (Gore et al. 2011; Lopez et al. 2006). 49
In many affected individuals, clear manifestations of manic 50
and depressive mood symptoms do not appear until ado- 51
lescence (Merikangas et al. 2007). During the adolescent 52
period, pivotal maturational and environmental events 53
occur that can trigger mood symptom onset according to 54
neurodevelopmental models of mood disturbance (Good- 55
win and Jamison 2007; Johnson and McMurrich 2006). It is 56
important to examine this period of risk in order to improve 57
diagnostic accuracy as well as to validate potential 58

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59 endophenotypic markers of mood disturbance (Gottesman
60 and Gould 2003; Hasler et al. 2006).

61 Although research on mechanisms underlying mood
62 symptom severity in adolescence has expanded in the last
63 decade (e.g., Geller and Luby 1997; Youngstrom et al.
64 2008), continued efforts to identify psychosocial processes
65 are needed. These research efforts promise to improve risk
66 assessment, diagnosis, and early targeted treatment (e.g.,
67 Miklowitz and Chang 2008; Youngstrom et al. 2005).
68 Adolescence is a developmental period characterized by
69 many changes in affective experience, particularly height-
70 ened emotional reactivity. For instance, across negative
71 and positive affective stimuli, adolescents exhibit increased
72 subjective, physiological and neurobiological responding
73 compared with younger children and adults (Larson and
74 Lampman-Petratis 1989; Quevedo et al. 2009; Somerville
75 et al. 2010; Silk et al. 2009). Subjective negative affect
76 appears to increase while subjective positive affect
77 decreases across adolescence (Larson et al. 2002; Henker
78 et al. 2002). Adolescents also report greater fluctuations in
79 daily emotional states, and this emotional variability itself
80 appears to change over adolescence as happiness, sadness
81 and anger all decline from early to late adolescence (Ma-
82 ciejewski et al. 2015). Given the numerous developmental
83 affective changes occurring during adolescence, we
84 specifically seek to investigate disturbances in emotional
85 valence systems in association with mood symptom dis-
86 turbance. Understanding these mechanisms may shed light
87 on inter-episode dysfunction and predict subsequent
88 relapse across psychiatric conditions and in BPSDs. This
89 emphasis is highly consistent with recent initiatives to
90 isolate disturbances in positive and negative valence sys-
91 tems through the NIMH Research Domain Criteria or
92 RDoC (e.g., Insel et al. 2010; Sanislow et al. 2010) and
93 more general models of positive emotion disturbance in
94 mood disorders (e.g., Hofmann et al. 2012; Stanton et al. in
95 press; Watson and Naragon-Gainey 2010).

96 Positive Emotions and Mood Symptom Disturbance: 97 Need for Specificity

98 Recent theories of mood disturbance, particularly for
99 BPSDs, implicate disturbances in positive emotional sys-
100 tems (e.g., Alloy and Abramson 2010; Gruber et al. 2011;
101 Johnson 2005). A hallmark feature of mania symptoma-
102 tology includes abnormally elevated and persistent positive
103 mood (American Psychiatric Association 2013). Descrip-
104 tive accounts of BPSDs prominently feature feelings of
105 “exuberance,” including experiences of excitement, inter-
106 est, and euphoria (Jamison 2005). More recent empirical
107 work converges with these observations to support the
108 centrality of positive emotional disturbances in bipolar
109 symptomatology (e.g., Gruber et al. 2014).

110 However, most work on bipolar mood disturbance has
111 traditionally emphasized broad dimensions of positive
112 emotion assessment. This includes measurement of unidi-
113 mensional constructs of “happiness” or “positive mood”
114 which lack specificity as to which particular emotions are
115 impacted. Recent work in affective science, importantly,
116 supports the validity of differentiating among a variety of
117 functionally distinct positive emotions that differ in their
118 function and response profile (Campos and Keltner 2014;
119 Fredrickson 1998; Shiota et al. 2006; Tracy and Robins
120 2004). Animal neuroscience models also encourage the
121 utility of differentiating among distinct emotional states
122 (Burgdorf and Panksepp 2006; Panksepp 1998). For
123 example, *joy* (or happiness) is a reward-oriented emotion
124 experienced when the environment signals an imminent
125 improvement in resources, motivating the individual to
126 acquire material resources and rewards such as joy (e.g.,
127 joy; Berridge and Kringelbach 2008; Harmon-Jones and
128 Gable 2009; Rolls 1999). Recent work on joy suggests it is
129 uniquely associated with behavioral displays (i.e., Duch-
130 enne smiles) that are robustly associated with self-reported
131 joy (Keltner et al. 2003). *Interest* (or curiosity) is experi-
132 enced when people encounter novel information usually
133 consistent with their current worldview, which promote
134 engagement with the environment and knowledge consol-
135 idation (Fredrickson 1998; Izard 1977; Shiota et al. 2006).
136 Although, *anger*—also a common feature of mania symp-
137 tom severity (American Psychiatric Association 2013)—is
138 negatively valenced, it shares many important neurophys-
139 iological and behavioral features with positive emotions,
140 including increased left hemispheric activation (Harmon-
141 Jones and Allen 1998) and approach behavior tendencies
142 towards the pursuit of goals (e.g., Carver 2004; Panksepp
143 1998; Youngstrom and Izard 2008). As an approach-or-
144 iented emotion that mobilizes the body to overcome an
145 obstacle impeding goal pursuit, anger is highly correlated
146 with positive affectivity (Harmon-Jones 2003; Harmon-
147 Jones and Gable 2009).

Positive Emotion and Adolescent Mood Disturbance

148 Understanding the concurrent relationship between positive
149 emotions and mood symptom severity in adolescence is a
150 high priority (e.g., Forbes and Dahl 2005; Gilbert 2012).
151 Yet there is little known about the ways specific emotions
152 map onto bipolar mood symptomatology. For example,
153 although mania symptoms in adolescents have been asso-
154 ciated with decreased neural activity and lower sensitivity
155 to identifying happy faces (Diler et al. 2013; Guyer et al.
156 2007; Rich et al. 2008), we know little about the specific
157 positive emotions driving these responses. Moreover,
158 adolescents at risk for or with depression demonstrate
159 blunted reward responding that is associated with lower
160

161 levels of daily positive emotion (Forbes et al. 2009) while
 162 decreased happiness predicts the onset of depressive
 163 symptoms (Neumann et al. 2011). Similar to adult litera-
 164 ture, adolescent BPSDs are characterized by dysregulated
 165 reward learning (Dickstein et al. 2009) and increased
 166 reward sensitivity and approach-motivated behaviors being
 167 associated with elevated manic symptoms (Gruber et al.
 168 2013). Taken together, elevated reward-seeking positive
 169 emotions (such as joy) and increased goal approach-moti-
 170 vated emotions (including anger) appear to be linked to
 171 manic and depressive symptoms in adolescents. This work
 172 underscores the clinical significance of applying a discrete
 173 emotions framework to mood disturbance in adolescence.

174 We suggest that a discrete emotions perspective may
 175 advance the study of adolescent mood disturbance for
 176 several reasons. First, application of a discrete framework
 177 has yielded unique insights into better understanding both
 178 manic and depressive symptom profiles in adults (e.g.,
 179 Gruber et al. 2010, 2011). For example, adults at risk for
 180 mania report specific elevations in high arousal positive
 181 emotions (e.g., joy and interest), which prospectively pre-
 182 dict increased mania symptom severity (Gruber et al.
 183 2009). Moreover, adults with bipolar disorder report
 184 greater approach-related emotions such as anger (Dutra
 185 et al. 2014). These findings suggest a potential benefit by
 186 applying similar methodological approaches to adoles-
 187 cents. Second, this work is an important contributor to a
 188 growing emphasis on understanding a variety of specific
 189 positive (and negative) emotions experienced in adoles-
 190 cence (e.g., Leibenluft 2011).

191 The Present Investigation

192 The present study examined whether theoretically relevant
 193 positive emotions (and approach-related negative emo-
 194 tions) represent an endophenotypic marker that contributes
 195 to BPSD-related mood symptoms in adolescents. Given
 196 growing emphasis on examining psychopathology pro-
 197 cesses and associated symptoms dimensionally (Insel et al.
 198 2010; Prisciandaro and Roberts 2011; Prisciandaro and
 199 Tolliver 2015), we focused on mania and depression
 200 symptom severity across a demographically diverse and
 201 diagnostically heterogeneous adolescent outpatient sample.
 202 Though we were primarily interested in examining the
 203 associations between emotion and mood symptoms
 204 dimensionally, we also performed a series of ANOVA
 205 models as sensitivity analyses to assess whether there were
 206 differences in average emotion scores across diagnostic
 207 categories. These results complement the main analyses by
 208 providing description of differences between diagnostic
 209 groups, which have the advantage of familiarity, combined
 210 with limitations due to heterogeneity of symptom presen-
 211 tation and comorbidity. We also examined whether the

212 emotion variables were associated with any of the demo-
 213 graphic variables (age, race, sex) using correlational anal-
 214 yses. Following these preliminary analyses, two primary
 215 aims were examined focusing on specific positive emotions
 216 as predictors of mania and depressive mood symptoms,
 217 respectively.

218 First, based on the supposition that a central psychoso-
 219 cial factor associated with increased manic symptoms in
 220 adults involves increased approach or pursuit of goals in
 221 the environment (Alloy and Abramson 2010; Johnson
 222 2005; Meyer et al. 2001; Urosevic et al. 2008), we tested
 223 whether elevations of specific positive emotions associated
 224 with goal approach such as *joy* (also referred to as
 225 excitement or happy) (Shiota et al. 2006) were associated
 226 with increased symptoms of mania (Hypothesis 1a). We
 227 additionally examined whether elevations in the negative
 228 emotions of *anger* and *contempt*—closely associated with
 229 symptoms of mania and approach behavior in the pursuit of
 230 goals (Carver 2004; Harmon-Jones and Allen 1998)—were
 231 also associated with increased symptoms of mania (Hy-
 232 pothesis 1b). To test these hypotheses, we first controlled
 233 for symptoms of depression, and then examined whether
 234 symptoms of mania were uniquely associated with self-
 235 reported joy and anger, but not other positive or negative
 236 emotions. We also examined whether this same relation-
 237 ship held when examining these same approach-related
 238 emotions (i.e., joy, anger, contempt) versus all other
 239 emotions using a validated hierarchical linear regression
 240 model (Blumberg and Izard 1985, 1986).

241 Second, based on the supposition that increased
 242 depressive symptoms in adults involves decreased pleasure
 243 and approach towards goals (Alloy and Abramson 2010;
 244 Davidson et al. 2002; Dillon and Pizzagalli 2010), we
 245 tested whether a deficit in the specific positive emotion of
 246 *joy* was associated with increased symptoms of depression
 247 (Hypothesis 2a). We additionally examined whether the
 248 specific negative emotion associated with reduced goal
 249 approach and pleasure, or *sadness* (Gable and Harmon-
 250 Jones 2010), was associated with increased symptoms of
 251 depression, based on work in children associating specific
 252 reports of sadness with increased depressive symptoms
 253 (Blumberg and Izard 1986) (Hypothesis 2b). To test these
 254 hypotheses, we first controlled for symptoms of mania, and
 255 then examined whether symptoms of depression were
 256 uniquely associated with self-reported joy (inversely), as
 257 well as the negative emotions of sadness, guilt and hostility
 258 also implicated with depressive symptoms. To gain greater
 259 specificity in our findings, we further examined whether
 260 this same relationship held examining these same four
 261 emotions (i.e., joy, sadness, guilt, hostility) versus all other
 262 emotions using a validated hierarchical linear regression
 263 model (Blumberg and Izard 1985, 1986). Finally, we used
 264 net regression (Cohen and Cohen 1983) to test whether any

265 of the emotion variables or covariates (age sex, race) was
 266 uniquely related to either manic or depressive symptoms
 267 (See Table 5).

268 Methods

269 Participants

270 English-speaking adolescents and their primary caregiver
 271 were recruited from two agencies: a consecutive case series
 272 of youth presenting for services from an urban community
 273 mental health center ($n = 293$) and youth who were
 274 recruited for a variety of treatment studies for bipolar
 275 disorder or for other childhood disorders from an academic
 276 outpatient medical center ($n = 108$). The resulting sample
 277 was demographically and diagnostically diverse; youth
 278 from the community mental health center were more likely
 279 to be Black [$X^2(4) = 219.38, p < .0001$] and youth from
 280 the academic medical center were more likely to have a
 281 BPSD diagnosis ($X^2(1) = 21.48, p < .0001$). Youth from
 282 the community mental health center reported more con-
 283 tempt [$t(392) = 2.27, p = .024$], youth from the academic
 284 medical center reported more self-directed hostility
 285 [$t(159.37) = 2.92, p = .004$]. There were no other signif-
 286 icant differences in self-reported positive or negative
 287 emotion or on other demographic variables. Potential par-
 288 ticipants were excluded if they suffered from a pervasive
 289 developmental disorder or cognitive disability. For the
 290 present study, only youth aged 11–18 were included given
 291 our specific a priori interest in adolescents' self-reported
 292 positive emotion. See Table 1 for demographic and clinical
 293 characteristics.

294 Measures

295 DSM-IV-TR Diagnoses

296 All DSM-IV-TR diagnoses for adolescent participants were
 297 made based on the information provided during a semi-
 298 structured interview using the Kiddie Schedule for Affec-
 299 tive Disorders and Schizophrenia—Present and Lifetime
 300 version (KSADS-PL; Kaufman et al. 1997), along with the
 301 mood disorders modules of the WASH-U-K-SADS (Geller
 302 et al. 2001), which inquires more extensively about
 303 symptoms of depression and mania. Raters were highly
 304 trained (criterion of $K > .85$ at the item level on five
 305 interviews conducted by a reliable rater, and then $K > .85$
 306 on five interviews they led themselves) prior to conducting
 307 interviews independently. Adolescent participants and their
 308 parents (or caregivers) were interviewed sequentially by
 309 the same rater, resolving discrepancies through re-inter-
 310 viewing and clinical judgment. KSADS interviews resulted

Table 1 Demographic, clinical, positive emotion, and negative emotion characteristics of adolescent outpatient sample

	$N = 401$
<i>Demographic</i>	
Age (years)	13.52 (1.83)
Female (%)	48.1
Race (%)	
African American	68.1
Caucasian	24.7
Asian	.5
Hispanic	2.0
Other	4.5
<i>Clinical</i>	
Primary diagnosis (%)	
Bipolar disorder	19.7
Depression	37.9
Disruptive behavior disorders	34.2
Other	8.2
Taking medication %	57.2
KDRS	24.17 (9.66)
KMRS	20.54 (9.40)
<i>Positive emotion (percent of maximum possible)</i>	
Joy	.56 (.24)
Interest	.47 (.24)
Surprise	.35 (.23)
<i>Negative emotion (percent of maximum possible)</i>	
Sad	.35 (.27)
Anger	.47 (.27)
Self-directed hostility	.24 (.25)
Shame	.33 (.25)
Guilt	.33 (.24)
Disgust	.25 (.22)
Contempt	.26 (.23)
Fear	.21 (.24)
Shy	.26 (.24)

KDRS KSADS Depression Rating Scale, *KMRS* KSADS Mania Rating Scale, *disruptive behavior disorders* attention deficit hyperactivity disorder, conduct disorder, oppositional defiant disorder and disruptive disorder not otherwise specified. Values represent mean values (with standard deviations in parentheses) unless otherwise noted

in DSM-IV diagnoses, including bipolar I, bipolar II, 311
 cyclothymic disorder, and bipolar not otherwise specified 312
 (NOS). The diagnosis of bipolar NOS was made in cases of 313
 hypomanic or manic symptoms that did meet criteria for 314
 another bipolar diagnosis, usually due to insufficient 315
 duration criteria. KSADS diagnoses were reviewed at a 316
 diagnostic consensus meeting, including at least one 317
 licensed clinician. The diagnostic consensus meeting fol- 318
 lowed the Longitudinal Evaluation of All Available Data 319
 (LEAD) standard of diagnosis to designate all diagnostic 320

321 categories (Spitzer 1983). LEAD diagnoses took into
 322 account the information collected through the K-SADS
 323 interview, prior treatment history, family history, and
 324 clinical judgment. For purposes of comparing groups of
 325 diagnoses, we used a hierarchical system of categories
 326 focused on mood disorders that has been used successfully
 327 in previous studies of mood disorders in youth (Young-
 328 strom et al. 2001; Youngstrom et al. 2008). Kappas for both
 329 BPSD diagnosis ($=.91$) and for all diagnoses ($=.95$) were
 330 good comparing consensus versus K-SADS diagnosis
 331 (Youngstrom et al. 2005).

332 *Mood Symptoms*

333 The KSADS diagnostic interview assessed adolescents'
 334 current and lifetime mood episodes. The KSADS Mania
 335 Rating Scale (KMRS) and KSADS Depression Rating
 336 Scale (KDRS) provided severity ratings of all mood
 337 symptoms relevant to the DSM-IV criteria for mania and
 338 depression (Axelson 2002). The KMRS scores ranged from
 339 11 to 58 ($M = 20.54$, $SD = 9.40$) and KDRS scores ranged
 340 from 12 to 52 ($M = 24.17$, $SD = 9.66$) with higher scores
 341 indicating greater symptom severity. Scores on both the
 342 KMRS and KDRS showed excellent internal consistency
 343 ($\alpha = .92$ and $.86$ in this sample, respectively). The present
 344 analyses used current episode ratings, based on a summary
 345 of youth and parent reported symptoms, in order to
 346 examine more state-specific associations between current
 347 mood symptom severity and emotional experiences in
 348 adolescents.

349 *Self-Reported Positive and Negative Emotion*

350 Self-reported positive and negative emotions were pro-
 351 vided by the adolescent using the Differential Emotions
 352 Survey, Fourth Revision (DES-IV; Izard et al. 1993). Its 36
 353 items are rated on a five-point scale from 1 (rarely or never)
 354 to 5 (very often) asking respondents to indicate the extent
 355 to which they experience each emotion in their daily life.
 356 The present study used all 12 DES-IV emotion subscales:
 357 Joy ($\alpha = .71$), Interest ($\alpha = .68$), Surprise ($\alpha = .67$),
 358 Sadness ($\alpha = .81$), Anger ($\alpha = .79$), Self-directed hostility
 359 ($\alpha = .80$), Shame ($\alpha = .73$), Guilt ($\alpha = .70$), Disgust
 360 ($\alpha = .68$), Contempt ($\alpha = .64$), Fear ($\alpha = .84$) and Shy-
 361 ness ($\alpha = .75$).

362 **Procedure**

363 Participants were enrolled consecutively. In rare cases
 364 when referrals exceeded capacity, participants were chosen
 365 at random. All parents (or caregivers) and adolescents
 366 completed the informed consent process. All participants
 367 were treatment seeking. The research interview occurred

shortly after intake, or served as the intake if the partici-
 pants were enrolling directly into one of several treatment
 studies open during the course of the study. During the
 parent's KSADS interview, the adolescent participant
 completed a series of questionnaires and other study
 components with a second research assistant, including the
 DES-IV. The adolescent then completed the KSADS with
 the same rater who had interviewed his/her parent on the
 same day.

377 **Results**

378 **Preliminary Analyses**

379 Before testing our hypotheses, we first assessed bivariate
 380 correlations between the DES-IV scores and the demo-
 381 graphic variables. Results revealed that age was negatively
 382 correlated with joy ($r = -.13$, $p = .01$)—consistent with
 383 other recent reports (Uusitalo-Malmivaara 2014)—and
 384 positively correlated with sadness ($r = .23$, $p < .0005$),
 385 anger ($r = .20$, $p < .0005$), and self-directed-hostility
 386 ($r = .13$, $p = .01$). However, age was not correlated with
 387 interest ($r = -.03$, $p = .51$), disgust ($r = .05$, $p = .35$),
 388 fear ($r = .00$, $p = .94$), guilt ($r = .04$, $p = .46$), shame
 389 ($r = .01$, $p = .80$), or contempt ($r = .10$, $p = .06$). For
 390 sex, females reported higher scores on anger ($p < .0005$),
 391 sadness ($p < .0005$), contempt ($p < .0005$), shyness
 392 ($p < .0005$), guilt ($p < .0005$), shame ($p < .0005$), self-
 393 directed hostility ($p = .001$), disgust ($p = .002$), surprise
 394 ($p = .014$), and fear ($p = .024$). Females reported lower
 395 scores on joy ($p = .04$). For race, Caucasians reported
 396 higher contempt ($p = .003$) and self-directed hostility
 397 ($p = .001$) scores compared to non-Caucasian participants.
 398 In order to control for these demographic variables, we
 399 included age, gender, and race in Block 1 of the regression
 400 models. We also tested whether the average DES-IV scores
 401 varied by diagnostic group (BD, MDD, disruptive behavior
 402 disorders, and other disorders). There were between group
 403 differences for the following emotions: sadness ($\eta^2 = .07$,
 404 $p < .0005$), joy ($\eta^2 = .07$, $p < .0005$), self-directed hos-
 405 tility ($\eta^2 = .06$, $p < .0005$), anger ($\eta^2 = .05$, $p = .001$),
 406 shame ($\eta^2 = .04$, $p = .002$), guilt ($\eta^2 = .04$, $p < .0005$),
 407 shyness ($\eta^2 = .04$, $p = .003$), and contempt ($\eta^2 = .03$,
 408 $p = .022$). There were no differences in reported interest,
 409 surprise, disgust, or fear (all $ps > .05$). Given our interest
 410 in measuring the relations between specific emotions and
 411 symptoms of mania and depression, independent of diag-
 412 nosis, we decided to include diagnosis (BPSD Y/N) in the
 413 final block of our regression analyses, in order to determine
 414 whether a bipolar diagnosis, above and beyond specific
 415 emotions, accounted for variance in manic or depressive
 416 symptoms. Finally, the relationship between symptoms of

417 mania and depression was assessed, and consistent with
418 previous research in adolescents (Youngstrom et al. 2008)
419 mood symptom scores were positively correlated with each
420 other ($r = .51, p < .0005$).

421 Aim 1: Emotion as a Predictor of Mania Symptoms

422 To assess the relationship between specific emotions with
423 symptoms of mania, we computed partial correlations
424 between symptoms of mania and each of the 12 discrete
425 DES-IV subscales while controlling for depression symp-
426 tom scores.¹ As indicated in Table 2, symptoms of mania
427 were significantly associated with increased joy (but no
428 other positive emotion terms) and a trend towards
429 decreased sadness (but no other negative emotion terms).

430 To gain greater specificity in our findings, we further
431 examined whether symptoms of mania were uniquely
432 associated with approach-oriented emotions (i.e., joy,
433 anger, contempt), over and above other emotions (i.e.,
434 shyness, guilt, interest, surprise, disgust, self-directed
435 hostility, shame, fear). Towards this aim we conducted a
436 hierarchical multiple regression (Blumberg and Izard
437 1985, 1986) with Block 1 controlling for of age, gender
438 (Male = 0, Female = 1) and race (Caucasian = 0, Non-
439 Caucasian = 1) as well as depressive symptoms (KDRS).
440 Block 2 included the primary emotions of interest (joy,
441 anger, contempt)² and Block 3 included all other emotions.
442 In Block 4, bipolar diagnosis (Y/N) was added to determine
443 whether diagnosis, above and beyond emotion, was asso-
444 ciated with manic symptoms. Missing data were deleted
445 listwise, multicollinearity diagnostics showed satisfactory
446 tolerance statistics, and Cook's distance and standardized
447 DFBeta for each predictor revealed no influential cases
448 (Cook and Weisberg 1982; Myers 1990). As shown in
449 Table 3, KDRS scores and demographic variables (Block
450 1) were significant predictors of KMRS scores ($R^2 = .29$),
451 with control variables of age ($\beta = -.10, p = .04$) and
452 KDRS ($\beta = .54, p < .0005$) predicting KMRS scores.
453 When mania-related emotions were added in Block 2, the
454 overall model was significant ($R^2 = .32, \Delta R^2 = .03$); both
455 joy ($\beta = .12, p = .01$) and contempt ($\beta = .11, p = .04$)
456 were positively related to KMRS scores. None of the

Table 2 Associations between manic and depression symptoms with discrete positive and negative emotions

	KMRS	KDRS
Positive emotions		
Joy	.15*	-.28*
Interest	.03	.01
Surprise	.03	.11
Negative emotions		
Sadness	-.10**	.37*
Anger	.00	.26*
Self-directed hostility	-.05	.28*
Shame	-.05	.22*
Guilt	-.07	.24*
Disgust	-.01	.15
Contempt	.10	.07
Fear	-.06	.19*
Shyness	-.08	.27*

Correlations of KDRS and emotions are controlling for KMRS;
Correlations of KMRS and emotions are controlling for KDRS

KDRS KSADS Depression Rating Scale, KMRS KSADS Mania
Rating Scale

* $p < .01$; ** $p < .05$

emotions added in Block 3 were significant. In the final
Block, bipolar diagnosis was a significant predictor
($\beta = .69, p < .001$; $\Delta R^2 = .37$). Age ($\beta = -.08, p = .02$),
and KDRS scores ($\beta = .27, p < .0005$) also remained
significant in the final model. Guilt ($\beta = -.09, p = .047$)
was the only significant emotion in the final model. In the
final model, 70 % of the variance in mania scores was
accounted for by the predictors.

Aim 2: Emotion as a Predictor of Depression Symptoms

To assess the relationship between specific positive emo-
tions with symptoms of depression, we computed partial
correlations between symptoms of depression and each of
the 12 discrete DES-IV subscales while controlling for
mania symptom scores. As indicated in Table 2, symptoms
of depression were associated with decreased joy (but no
other positive emotion terms) and increased sadness, anger,
self-directed hostility, shame, guilty, disgust, fear and
shyness (but not contempt).

Again, we further examined whether symptoms of
depression were uniquely associated with reduced
approach-oriented emotions (i.e., joy) as well as negative
emotions associated with loss and low approach-motivation
and self-directed negative feelings common in depression
(i.e., sadness, guilt, self-directed hostility), above and all

1FL01 ¹ Given that the individual emotion 'interest' may be dysregulated in
1FL02 mania (e.g., interest and engagement in goal-directed activities is a
1FL03 symptom of mania) and depression (e.g., decreased interest usually
1FL04 pleasurable activities is a symptom of depression) we also moved
1FL05 interest into Block 2 of regressions as a primary emotion of study.
1FL06 When doing so, Blocks and individual emotion significance remained
1FL07 unchanged and interest was not a significant predictor of symptoms.

2FL01 ² Given the high rate of mixed symptom presentations among
2FL02 adolescents with mood disorders, and high degree of depressive
2FL03 features in hypo(mania) (e.g., Kraepelin 1921; Hunt et al. 2009;
2FL04 Kowatch et al. 2005; Van Meter et al. 2016), we chose to statistically
2FL05 control for symptoms in our planned analyses.

Table 3 Hierarchical multiple regression analyses using mania-relevant emotions to predict current manic symptoms

Predictor	KMRS		KMRS (not controlling for KDRS)	
	ΔR^2	β	ΔR^2	β
Block 1: demographics and symptoms	.29***		.03*	
Age		-.10*		.01
Female		.02		.13*
Caucasian		.08		.14*
KDRS		.54***		—
Block 2: mania-relevant emotions	.03**		.03*	
Joy		.12*		.02
Anger		-.03		.08
Contempt		.11*		.13*
Block 3: other emotions	.01		.01	
Joy		.15*		.05
Anger		.04		.09
Contempt		.13*		.14*
Shyness		-.06		.02
Guilt		-.05		-.05
Disgust		.03		-.04
Self-directed hostility		-.03		.07
Shame		.02		-.02
Fear		-.00		-.04
Interest		-.07		-.05
Surprise		-.02		.04
Sadness		-.07		.03
Block 4: diagnosis	.37***		.58***	
Joy		.03		-.02
Anger		.01		.02
Contempt		.04		.03
BPSD diagnosis		.69***		.79***

Mania relevant emotions shown in Block 2 and subsequent Blocks 3 and 4

KDRS KSADS Depression Rating Scale, KMRS KSADS Mania Rating Scale, BPSD bipolar spectrum disorder

* $p < .05$; ** $p < .01$; *** $p < .001$

482 other emotions (i.e., shame, anger, disgust, contempt, 483
shyness, fear, interest, surprise) using the same analytic 484
approach described above (Blumberg and Izard 485
1985, 1986). As shown in Table 4, KMRS scores and 486
demographic variables (Block 1), were significant 487
($R^2 = .35$) with control variables of age ($\beta = .20$, 488
 $p < .001$), gender ($\beta = .15$, $p = .002$), and KMRS 489
($\beta = .50$, $p < .0005$) scores predicting KDRS scores. 490
When hypothesized emotions of interest were added in 491
Block 2, the overall model was significant ($R^2 = .43$, 492
 $\Delta R^2 = .08$), with age ($\beta = .154$, $p = .001$) and KMRS 493
scores ($\beta = .48$, $p < .0005$) remaining significant, along 494
with the emotions of joy ($\beta = -.16$, $p < .0005$) and sad- 495
ness ($\beta = .18$, $p = .01$). None of the emotions added in 496
Block 3 were significant predictors. In the final Block,

bipolar diagnosis was not a significant predictor 497
($\beta = -.03$, $p = .68$; $\Delta R^2 = .00$). Age ($\beta = .15$, 498
 $p = .001$), KMRS scores ($\beta = .51$, $p < .001$), and joy 499
($\beta = -.19$, $p < .0005$) were also significant predictors in 500
the final model; predictors accounted for 44 % of the 501
variance in depression scores. 502

503 Finally, net regression analysis, was used to test whether 504
any of the emotion scores or demographic variables were 505
uniquely related to the mood symptom scales (See 506
Table 5). The results indicated joy is more strongly related 507
to mania scores than to depression scores ($p = .002$). 508
Additionally, older age was more strongly associated with 509
depression scores than mania scores ($p = .005$). The other 510
emotion variables did not have a stronger relation with 511
either mood symptom scale.



Table 4 Hierarchical multiple regression analyses using depression-relevant emotions to predict current depressive symptoms

Predictor	KDRS		KDRS (not controlling for KMRS)	
	ΔR^2	B	ΔR^2	β
Block 1: demographics and confounds	.35***		.11***	
Age		.19***		.20***
Female		.14**		.21***
Caucasian		.04		.11
KMRS		.50***		—
Block 2: depression-relevant emotions	.08***		.10***	
Sadness		.17*		.21**
Self-directed hostility		.03		.06
Guilt		.04		.01
Joy		-.16***		-.13*
Block 3: other emotions	.02		.02	
Sadness		.16		.17
Self-directed hostility		.03		.06
Guilt		.03		.00
Joy		-.20***		-.17**
Disgust		-.09		-.11
Contempt		-.06		.01
Shyness		.13		.14
Fear		-.04		-.06
Interest		.06		.04
Surprise		.08		.10
Anger		.04		.08
Shame		-.07		-.08
Block 4: diagnosis	.00		.13***	
Sadness		.15		.20*
Self-directed hostility		.03		.05
Guilt		.03		-.02
Joy		-.19***		-.21**
BPSD diagnosis		-.03		.37***

Depression relevant emotions shown in Block 2 and subsequent Blocks 3 and 4

KDRS KSADS Depression Rating Scale, KMRS KSADS Mania Rating Scale, BPSD bipolar spectrum disorder

* $p < .05$; ** $p < .01$; *** $p < .001$

512 Discussion

513 Research on positive emotion disturbance has gained
 514 increasing attention, yet it has remained less clear the
 515 concurrent and likely bidirectional relationship between
 516 positive emotions and mood symptoms during the critical
 517 period of adolescence. This is especially pertinent for
 518 identifying potential endophenotypic markers associated
 519 with illness onset and course. We investigated associations
 520 between mood symptoms and self-reported positive and
 521 negative emotions in a large adolescent outpatient sample.
 522 Results suggested unique associations between symptoms
 523 of mania with both increased joy and contempt, and
 524 between symptoms of depression with both increased

sadness and decreased joy. These patterns were indepen- 525
 526 dent of specific diagnosis, underscoring the importance of
 527 adopting a dimensional approach to thinking about mood
 528 pathology (Helzer et al. 2006; Insel et al. 2010; Sanislow
 529 et al. 2010). These findings extend work on specific emo-
 530 tions implicated in mood pathology in adulthood, and
 531 illuminate associations between emotions associated with
 532 goal driven behavior with mood symptom severity in
 533 adolescence.

534 The first aim assessed the relationship between specific
 535 emotions with symptoms of mania in adolescents. Consis-
 536 tent with our predictions, symptoms of mania were
 537 associated with joy and contempt, but not with any other
 538 positive or negative emotions. With respect to joy, these

Table 5 Net regression analyses using emotions and covariates (age, sex, race) to predict the difference between the predicted BDI score for each participant, based on the IVS, and his/her true KMRS score (i.e., KMRS–KDRS)

Predictor	KMRS–KDRS	
	ΔR^2	B
Block 1: demographics	.05***	
Age		-.11**
Female		-.16
Caucasian		.06
Block 2: emotions	.09***	
Sadness		-.53
Anger		.03
Self-directed hostility		.01
Joy		.93**
Shame		.22
Guilt		-.21
Interest		-.37
Surprise		-.26
Disgust		.34
Contempt		.54
Shyness		-.51
Fear		.09

KDRS KSADS Depression Rating Scale, KMRS KSADS Mania Rating Scale

* $p < .05$; ** $p < .01$; *** $p < .001$

539 findings dovetail with a growing literature suggesting
540 mania symptoms involve a heightened focus on the pursuit
541 of rewards and ambitious goals (Alloy and Abramson
542 2010; Johnson 2005; Meyer et al. 2001). Importantly in the
543 emerging adolescent literature, these findings are consistent
544 with work among outpatient adolescents suggesting that
545 reward-relevant positive emotions were concurrently
546 associated with increased manic symptom severity (Gruber
547 et al. 2013). This work also is also consistent with research
548 in adults with BPSD suggesting that increased reward
549 sensitivity is concurrently associated with increased manic
550 symptoms, providing encouraging support for develop-
551 mental continuity in positive associations between reward-
552 relevant emotions and mania symptoms (Alloy and
553 Abramson 2010; Johnson 2005; Meyer et al. 2001; Uro-
554 sevic et al. 2008). Our findings are also aligned with the
555 adult literature suggesting that adults at risk for mania
556 show unique elevations in self-reported positive emotions
557 like joy, but not other types of other-oriented or low-
558 arousal positive emotions (Gruber and Johnson 2009).
559 These findings are also consistent with emerging literature
560 suggesting that heightened reward sensitivity—which
561 covaries with the experience of emotions like joy—may

represent a candidate risk indicator for, and targeted
treatment foci of, bipolar disorder (e.g., Alloy et al. 2015;
Duffy et al. 2015). Interestingly, results between emotions
and mania were only significant when controlling for
depressive symptoms, but results held for depression when
controlling manic symptoms. There are several potential
interpretations of these results including potential covari-
ation in symptom presentation common in mixed states,
reliance on caregiver reports for symptom ratings scales
which may be less sensitive to identifying manic versus
depressive symptoms (e.g., Freeman et al. 2011; Young-
strom et al. 2015). Future work is warranted to continue to
probe these and other possibilities, underscoring the
importance of detecting underlying mechanisms, such as
trait affect, driving both mood symptom presentations.
Taken together, these findings suggest that increased manic
symptoms during this critical neurodevelopmental phase
may also be tied to emotional experiences related to goal
pursuit and attainment. It will be important to continue to
examine the role of specific types of positive emotionality
in the developmental trajectory of BPSD across time, with
a particular focus on reward-related positive states.

Additionally, the results indicating an association
between contempt and manic symptoms in adolescence is
consistent with work that has found heightened contempt
among both adult (e.g., Dutra et al. 2014, 2016) and ado-
lescent (Leibenluft 2011) bipolar populations. Importantly,
elevations in contempt have been associated with height-
ened sensitivity of the Behavioral Approach System (Car-
ver 2004; Harmon-Jones and Allen 1998), a central process
implicated in the etiology of BD (Urosevic et al. 2008).
This suggests that heightened contempt may arise when
goal pursuit is thwarted and subsequently trigger the gen-
eration and exacerbation of mania in adolescents as well as
adults (e.g., Johnson 2005). High levels of contempt may
also help to explain the conflict and stressful interpersonal
relationships common among adolescents with bipolar
disorder (Algorta et al. 2011; Coville et al. 2008; Du
Rocher Schudlich et al. 2008; Siegel et al. 2015), given a
robust literature associating contempt with distinctly toxic
effects in interpersonal relationships (Gottman 1994).

The second aim assessed the relationship between
specific emotions with symptoms of depression in adoles-
cents. Consistent with our predictions, symptoms of
depression were uniquely associated with decreased joy
and increased sadness, but not with any other positive or
negative emotions, findings that also held when controlling
for symptoms of mania and bipolar diagnosis. These results
converge with robust findings in adults that postulate a core
feature of depression involves decreased pleasure and
approach towards goals (Alloy and Abramson 2010;
Davidson et al. 2002; Dillon and Pizzagalli 2010) and
decreased positive affectivity more generally (Brown et al.

1998; Chorpita and Daleiden 2002; Clark and Watson 1991; McMakin et al. 2011), which would be reflected in reduced joy. Our results associating increased sadness with depression symptoms are highly convergent with clinical observations (American Psychiatric Association 2013) and extant empirical work associating depression with increased reports of sadness in adults (e.g., Rottenberg et al. 2002). In addition, these results are supported by work linking sadness measured from a similar DES-IV self-report scale to prospective prediction of depression symptoms at a 4-month follow-up in children (Blumberg and Izard 1985, 1986). In RDoC terms, depression involves at least two major domains: increased negative affect, and decreased positive affect—corresponding to anhedonia and loss of interest as core features, and the “low PA” component of the tripartite model of depression and anxiety (Clark and Watson 1991). Future work should explore whether emotion-regulation strategies that feed sadness levels heighten adolescent depression (e.g., Millgram et al. 2015).

The results of the present study need to be interpreted within the confines of several limitations. First, the results of the present study were assessed exclusively with self-report indices of emotional states. Although this represented a good first step, future studies should utilize experimental inductions of distinct types of emotional states (e.g., emotion-eliciting films or images) and measuring concurrent physiological and behavioral indices of reward sensitivity. In addition, it will be valuable to more carefully examine a broader array of distinct positive emotional states moving forward. Second, the sample was comprised of a demographically diverse sample that contained a high percentage of low-income African-American adolescent families. Although this represents a strength of the present research by representing underserved and understudied minority groups, it may complicate direct comparisons with previous work. Third, we did not assess for pubertal status and its influence on emotion experience, especially important given differences in reward processing associated with pubertal timing. Fourth, the current study was cross-sectional and, as such, a longitudinal prospective high-risk sample design is warranted to more clearly disentangle the causal relationship between emotions and mood symptoms.

Despite these limitations, the present study adds to the small, but growing, literature examining associations between emotional experience and mood symptom severity, extending this work in a demographically diverse adolescent sample. Such findings advance our understanding of the relevance of these valenced systems in the etiology of mood psychopathology and targeted remediation with an explicit focus on emotional processing. The availability of free scales that measure focal constructs

such as contempt and joy make it possible for both researchers and clinicians to examine the relevance of these constructs (Izard et al. 1993). Future steps include should identifying behavioral and pathophysiological processes associated with disrupted emotion processes in adolescents that may ultimately inform preventative treatment development.

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Compliance with Ethical Standards

Conflict of Interest June Gruber, Anna Van Meter, Kirsten Gilbert, Jennifer Kogos Youngstrom, and Norah Feeny declare that they have no conflict of interest.

Informed Consent Informed consent procedures were followed in accordance with the ethical standards of the responsible committees on human experimentation at the University Hospitals of Cleveland and Applewood Centers. Informed consent was obtained from all individual subjects participating in the study.

Animal Rights No animal studies were carried out by the authors for this article.

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