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Heterotyic and Homotypic Continuity: The Moderating Effects of Age and Gender

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Abstract The longitudinal relationships between depression, anxiety, conduct problems, and inattention were investigated. The present study attempted to overcome the methodological limitations of prior research on childhood co-occurring syndromes by using continuous measures of constructs, controlling for multiple symptoms at baseline, and considering the role of age and gender. Using a community sample of 6–11 year-old children, we found evidence of homotypic and heterotypic continuity in baseline characteristics and their symptoms 5 years later. Notably, inattention and conduct problems were stable over time regardless of age or gender. Additionally, inattention predicted subsequent depression, a relationship unaffected by overlapping psychopathology. With attention problems considered, conduct problems did not predict future depression as others have predicted. Instead, depression in young children was a unique risk factor for subsequent conduct problems. Similarly, most other relationships were moderated by age or gender. The implications for understanding childhood psychopathology and for designing prevention and treatment programs are discussed.

Keywords Conduct problems · Anxiety · Inattention · Depression · Developmental psychopathology

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Depression, conduct problems, anxiety, and inattention are serious problems that affect a large number of children and adolescents. Further, these problems co-occur at a higher rate than would be expected by chance, a finding that is not due to methodological artifact or the result of overlapping diagnostic criteria (see Angold et al. 1999 for a review). Strong relationships have reliably been demonstrated in studies using diagnostic variables such as major depressive disorder, attention deficit hyperactivity disorder (ADHD), and conduct disorder (CD), as well as studies using continuous measures reflecting similar constructs (Leech et al. 2005; Volk et al. 2005). One childhood syndrome seldom occurs in isolation from the others (Angold et al. 1999). The research concerning symptom co-occurrence raises questions about the developmental progression of different forms of psychopathology. In particular, the present study addresses the question of whether depression, anxiety, inattention, and conduct problems that are manifested at one stage of development lead to a similar or different manifestation of psychopathology as development unfolds.

Theoretical Explanations of Co-occurring Syndromes

Given the high rate of psychiatric comorbidity in pediatric populations, several authors have called for better theories and more research to explain the etiology, treatment, and prevention of common comorbid disorders (Clarkin and Kendall 1992; Jensen 2003). Unfortunately, most existing theories suffer from significant limitations including focusing on adult rather than child presentations, singular (conduct-depression) rather than multiple co-occurrences (ADHD-depression-conduct), and static rather than variant symptoms over time (Herman et al. 2007). Even when

theorists have considered developmental and dynamic aspects of co-occurrence, one can find contradictory theories to explain the same phenomenon. For instance, many researchers have proposed specific models with hypothesized psychosocial pathways between ADHD, Conduct Disorder, and depressive symptoms and disorders (Kovacs et al. 1988; Ostrander and Herman 2006; Patterson et al. 1993). Patterson and colleagues suggested that the high rate of comorbidity between externalizing disorders and depression may originate with early conduct problems (Patterson et al. 1993). According to their cascade model, "antisocial symptoms are a direct cause of school failure and an indirect cause of depression" (Patterson et al. 1993; p. 68). On the other hand, Kovacs and colleagues (1988) have reported that depression may contribute to the development of disruptive behavior symptoms in early adolescence which gradually supersedes and replaces depressive symptoms which abate. Still others contend that the apparent link between externalizing and internalizing symptoms is accounted for by their shared relationships with inattention (Hinshaw 1992; Ostrander and Herman 2006).

Our research is conceptually grounded in the life course/social field framework (Kellam et al. 1975) which emphasizes developmental psychopathology and epidemiology concepts. Major strengths of the theory applied to understanding childhood psychopathology include its emphasis on age-specific developmental tasks and challenges as well as time variant symptom manifestations. Central to life course/social field theory is the concept that individuals face specific social task demands in specific social fields across the major transition periods over the life span (Kellam and Rebok 1992; Rindfuss 1991). The salience of particular social fields and their task demands varies across the life course.

One key developmental challenge early in the life course is entrance into the school social field, where the child is confronted with the teacher's demands for academic achievement, compliance, attention, and participation in classroom and peer activities. Significant psychiatric symptoms such as inattention, conduct problems, or depression at school entry interfere with a child's ability to meet these task demands. Unsuccessful adaptation to the school social field as evidenced in academic failure places children at risk for chronic school failure which in turn undermines their psychological well-being. In this way early psychiatric symptoms leads to unsuccessful adaptation which in turn causes further psychiatric problems. Later developmental transitions (e.g., entrance into middle school) present additional challenges for children. Research generally supports predictions of the life-course/social field theory (Kellam et al. 1975; Ialongo et al. 1999). Life course/social field theory emphasizes developmental psychopathology principles for understanding the emergence of psychiatric symptoms. Two of these concepts include homotypic and heterotypic continuity.

Temporal Relationship of Psychopathology: Homotypic and Heterotypic Continuity

Most studies have reported a remarkable level of stability in the symptoms associated with inattention, and internalizing or externalizing disorders (Angold et al. 1999; Costello et al. 2003; Larsson et al. 2004; Roza et al. 2003). Such "homotypic continuity" is represented when a form of psychopathology is consistently displayed over time; however, the specific symptoms may have somewhat different manifestations over time. For example, studies that have followed the developmental course of internalizing symptoms often find that anxiety precedes subsequent depression (Brady and Kendall 1992; Roza et al. 2003); in contrast, a progression from depression to anxiety is less likely (Costello et al. 2003; Roza et al. 2003). While homotypic continuity of symptoms is common, "heterotypic continuity" is to also to be expected, that is, one form of psychopathology may contribute to the emergence of a different form of psychopathology (Angold et al. 1999).

A number of studies have illustrated a strong relationship between attention deficits and other forms of internalizing and externalizing disorders. Early attention problems have demonstrated a unidirectional (Burke et al. 2005; Fischer et al. 2002), bidirectional (Lahey et al. 2002) or indirect (Hinshaw and Lee 2003) relationship with other forms of psychopathology. Some researchers have proposed that the relationship between attention problems and certain forms of psychopathology (i.e., depression) may be "epiphenomenal", that is, better accounted for by the overlapping effect of other disorders (Angold et al. 1999).

Similar to the conflicting theoretical explanations described above, research concerning the temporal relationship between internalizing and externalizing disorders has also led to contradictory findings. Some researchers have found that depression is a precursor for nonaggressive late-onset conduct disorder (Puig-Antich 1982), while others have demonstrated that disruptive behavior is an antecedent to depression (Holmes and Robins 1987; Kovacs et al. 1988). Longitudinal studies suggest that conduct and other externalizing disorders may predict later anxiety (Roza et al. 2003). Interestingly, other researchers have reported that anxiety can alternately suppress or intensify the consequences associated with conduct problems (Costello et al. 2003; Frick 2006; Rutter et al. 1998).

The available research highlights the ambiguity concerning how different forms of psychopathology interrelate over time. According to life course/social field theory,

further considerations of how gender and development moderate the level of homotypic and heterotypic continuity may help clarify some of the conflicting findings described above.

The Role of Gender in Moderating Homotypic and Heterotypic Continuity

For the most part, the investigations of gender differences in the progression of psychopathology have been confined to the mean level of impairment across genders; by contrast, far fewer investigations have focused on the role of gender in explaining differential causal processes (Rutter et al. 2003). For instance, there has been reliable evidence that boys tend to have higher rates of conduct (Loeber and Keenan 1994) and attention disorders (Barkley 2003); whereas girls consistently exhibit higher rates of internalizing disorders, particularly depression (Wade et al. 2002).

Genetic variation across the sexes may help explain the differential rates associated with various forms of psychopathology. However, genetic considerations probably represent a distal cause of disorder, with a variety of biological and environmental mechanisms having a more proximal causal influence (Rutter et al. 2003). Certain disorders (e.g., ADHD) have demonstrated a particularly strong genetic influence (Bergen et al. 2007); however, these disorders may have differential consequences associated with being male or female. For example, some researchers have noted that depressive symptoms are likely to follow externalizing symptoms in females more so than in males (Moffitt et al. 2001), suggesting that the psychosocial consequences associated with having an externalizing disorder may be a particularly salient source of stress for women, increasing their risk for depression during the transition from childhood to adolescence (Wade et al. 2002).

Longitudinal studies have yielded contradictory findings concerning whether gender moderates the expression of homotypic and heterotypic continuity. For example, research involving males with disruptive behavioral disorders suggests that there is considerable homotypic and heterotypic continuity (Lahey et al. 2002); yet, research involving community-based samples has been inconclusive. In some instances only females have displayed heterotypic continuity (Costello et al. 2003); in other studies, gender did not influence the homotypic or heterotypic continuity of psychopathology (Burke et al. 2005). These finding suggest that the temporal relationship between various forms of psychopathology may be different for males and females. As a result, gender is an important variable for consideration when determining the course and interplay of symptoms over time.

The Role of Development in Moderating Homotypic and Heterotypic Continuity

Life course/social field theory emphasizes the interaction of early experiences with later (mal)adaptation and that psychopathology must be viewed within a developmental context. Thus, normal developmental processes are expected to influence the homotypic and heterotypic continuity of psychopathology. Genetic, cognitive and psychosocial transformations that occur during transition into adolescence may moderate the interplay between various disorders. For example, certain genes are also likely to be switched on and off during puberty (Pickles et al. 1998); when activated, these 'new' genetic effects may contribute to the onset and stability of certain forms of psychopathology (Lau and Eley 2006).

In addition to the normal developmental variability in genetic factors, adolescence is also associated with cognitive and social transformations. During childhood cognitions of young children are more likely to be unstable, transient and directly dependent upon specific interactions with the environment (Bierman and Montminy 1993; Dweck and Leggett 1988; Nicholls and Miller 1984). In contrast, the cognitive appraisals of adolescence become more stable (Cicchetti and Toth 1995); moreover, with advancing age adolescents are increasingly able to view themselves according to the perspective of others (Eccles et al. 1993; Nicholls and Miller 1984). Parents are clearly the key social influence for children (Damon 1983); however, with onset of adolescence the social significance of parental interactions decline while the salience of peer relations increases (Kellam and Rebok 1992; Larson and Richards 1991; Steinberg and Silverberg 1986). Cognitive and social factors have been associated with both the consequences and antecedents of virtually every form of psychopathology; in some cases, these factors may play a role in mediating the relationship between various forms of psychopathology (Capaldi 1991; Herman and Ostrander 2007; Moffitt 1990; Ostrander et al. 2006; Ostrander and Herman 2006). Thus, the causal pathways that underlie homotypic and heterotypic continuity may display fundamentally different patterns during childhood and adolescence (Cicchetti and Toth 1995). As a result, the interplay, stability, and social significance of different forms of psychopathology may be directly or indirectly moderated by development (Kellam et al. 1975).

Delineation of the developmental course of symptomatology has been emphasized as a priority in the development of psychiatric classification (Widiger and Clark 2000), and toward improving strategies for prevention and intervention (Cicchetti and Toth 1992). Investigating the dynamics underlying the evolution of psychiatric symptoms across developmental time points may promote understand-

ing of the causes of disorder as well as the potential sources of continuity and discontinuity. Moreover, understanding these processes can lead to more targeted interventions and may ultimately have major public health implications.

Methodological Considerations

While there is increasing evidence that gender and age may moderate the interplay between various forms of psychopathology, recent reviews have identified a number of methodological considerations that must be addressed before arriving at valid conclusions concerning the nature of this interplay (Caron and Rutter 1991; Rutter et al. 2003; Rutter et al. 2006). For example, studies that have examined the temporal relationship between various forms of psychopathology have typically relied on DSM-IV categorical diagnosis (e.g., Burke et al. 2005; Costello et al. 2003). Yet, studies in both the child and adult literature indicate that many diagnoses may be better represented by a dimensional approach rather than by categorical constructs (Hudziak et al. 1999; Kendler et al. 1996). Imposing a categorical structure upon a dimensional phenomenon is apt to distort the actual nature of the underlying relationship between pathological constructs (Caron and Rutter 1991), a problem that becomes magnified when making subtle distinctions between highly correlated constructs (Ostrander et al. 1998). Therefore, in the present study we used dimensional constructs when examining the temporal relationship between various forms of psychopathology.

Additionally, many of the studies that have tracked the developmental course of various forms of psychopathology have relied on clinic samples (e.g., Burke et al. 2005; Frick 2006; Fischer et al. 2002; Kovacs et al. 1988; Lahey et al. 2002; Loeber and Keenan 1994). Because the probability of being referred to a clinic increases with the extent of comorbidity, the referral bias associated with clinic samples may lead to misleading conclusions concerning the co-occurrence of psychopathology (Caron and Rutter 1991). The current study will be comprised of a community sample; consequently, the findings will be more broadly representative.

The high level of symptom co-occurrence provides methodological challenges when examining the correlates of any particular pathological construct. For example, when three or more conditions are all associated with one another, any pairwise association may be an artifact of overlapping pathology (Angold et al. 1999). Yet, much of what is currently known about child and adolescent psychopathology is limited to studies where disorders are treated as isolated constructs (Lilienfeld 2003). To further our understanding concerning the longitudinal progression of various forms of psychopathology, the current study will control for symptom co-occurrence at baseline.

While there is both theoretical and empirical basis for expecting that age and gender will moderate the homotypic and heterotypic continuity of psychopathology, one of the major challenges involved in testing interaction effects concerns the issue of statistical power. McClelland and Judd (1993) provide a cogent illustration of the power restrictions associated detecting interaction effects in samples that have a restricted range of scores. This issue is particularly relevant when conducting research on community samples, where there is a clustering of scores and few extreme scores. To address this issue, oversampling extreme scores may be the best approach when attempting to detect interaction or moderation effects. (Cohen et al. 2003; McClelland and Judd 1993; Whisman and McClelland 2005). The current study will follow these recommendations. The present study investigates the unique longitudinal relationships between depression, anxiety, conduct problems, and inattention, and the potential moderating effects of age and gender. In the process, the study addresses most of the methodological limitations associated with other studies while examining how age and gender moderated the homotypic and hetrotypic continuity of psychopathology over the course of childhood development.

Method

Participants

A community population of 7,231 children, initially in Grades 1–4, attending 22 schools, were screened using a sequential, two-stage assessment strategy. Based on parent and teacher ratings, each exceeding 1.75 SD units above the mean on the 10-item Hyperactivity Index (HI) of the Revised Conners Rating Scales (Goyette et al. 1978), 309 (4.3%) children exhibiting high levels of problematic behavior across settings were identified. Comparison students were selected if they (a) scored less than 1 *SD* above the mean on the teacher version of the HI, (b) had no history of psychotropic medication use, and (c) had no prior history of clinical assessment for behavioral problems. The mean scores on the parent and teacher screening measure (HI) were at floor levels, suggesting only a remote possibility that any of these children would be diagnosed with a disruptive behavioral disorder. Ten percent of the eligible students meeting these criteria were randomly selected from the school population and were further stratified to match the proportional representation of the participants according to school, grade, and gender (August et al. 1995).

After the identification process, the sample consisted of 309 problem and 144 non-problem children (total N=453)

ranging in age from 6.6 to 11.75 years. The sample was 79% male, 95% Caucasian and predominantly middle class, although all socioeconomic levels, as determined by the Hollingshead (1975) index, were represented. The selection process assured an adequate sampling of children with relatively high rates of psychopathology and represented a wide range of internalizing and externalizing disorders (August et al. 1995).

Selection Procedures

The research protocol was approved by the Institutional Research Review Board Committee on Human Subjects. Parents from the entire school population were required to provide consent for their child to participate in the initial screening and identification phase. As part of the initial consent, parents were informed of the classroom-wide assessment procedure and asked to consent to their child's participation. Approximately 5% of the school population refused participation. All parents and their children that met the initial screening criteria provided consent/assent before moving on to the diagnostic and assessment phase of the study.

Several months after the screening, parents completed mailed questionnaires, and teachers completed questionnaires distributed in the schools. During this time, one school district's catchment area was redrawn and some students were assigned to a new school district that did not participate in the study. Reassignment to a nonparticipating school district was the primary reason that 75 children that were identified with problems were unable to participate in the study. Of the original 144 non-problem children, a total of 130 agreed to participate in the study and completed at least some of the assessment tools. Most nonresponders were lost due to reassignment to another school district or move from their original school district. A comparison of the participants and nonparticipants found the groups to be indistinguishable on SES status, family size, single parent status, the ages of parents and children, and their scores on the respective parent and teacher HI screening measures.

Instruments

Behavioral Assessment System for Children (BASC) The BASC (Reynolds and Kamphaus 1992) is a multisource and multidimensional assessment system that includes separate report measures that are derived from respective self, parent, and teacher respondents. The BASC was constructed using structural equation modeling; as such the non-overlapping content of the respective scales reflect a "pure" index of the constructs of interest. This allowed for greater precision in the respective scale construction; thus, the individual scales should correlate with each other only to the extent predicted from the correlations between the constructs underlying the scales (and not due to overlapping items or due to item content that overlaps with an adjacent construct). The need for item purity is particularly important when examining the relationship between constructs that are expected to be highly related (e.g., conduct and attention problems).

The *BASC-Parent Report Scale* (BASC-PRS; Reynolds and Kamphaus 1992) is a multidimensional measure designed to assess adaptive and problem behaviors in children at three age levels: preschool (4–5 years), child (6–11 years), and adolescent (12–18 years). The parents participating in the study completed the child version of the BASC-PRS, which is comprised of 130 items rated on 4-point frequency scales ranging from 0 ("never") to 3 ("always"). The Conduct Problems and Attention Problems subscales were used in the present study. The BASC manual provides compelling evidence of the respective scales' convergent and discriminant validity; furthermore, independent research using confirmatory factor analysis have support both scales validity (Crystal et al. 2001). Additionally, high scores on the Attention Problems subscale are particularly effective at identifying children with ADHD (Ostrander et al. 1998).

The *BASC-Self Report Scale* (BASC-SRS; Reynolds and Kamphaus 1992) is a self-report measure for children 8–11 years-old comprised of 152 items that are rated as either true or false by the child. The depression and anxiety scales were used in the present study. The manual and independent research has provided support both scales validity (Crystal et al. 2001; Reynolds and Kamphaus 1992). A subset (n=86) of the participants was between 7 and 8 years of age when BASC-SRS was initially administered. However, no significant differences between scores of children below 8 years and those above 8 years old were found for any of the self-report scales used in the present investigation. Moreover, the correlations among these scales were not significantly different for children under 8 and those between 8–8.5 years-old (p>0.05). Thus, children under the age of 8 responded in a similar manner as children who were slightly older suggesting that the discriminant and convergent validity of the BASC-SRS was comparable for children just under and over 8 years of age.

Attrition Analyses Baseline data were nearly complete for measures derived from child self-report (2% missing data) and 80% complete for parent-report measures. Missing data analyses were conducted comparing those participants who completed all the measures at baseline with those who did not. Independent t-tests, and chi square tests for nominal variables, revealed no significant differences between the

groups at baseline on demographic (e.g., SES, age, gender), predictor, or outcome variables (ps>0.05).

At 5 year follow-up, 168 parents returned parent questionnaires. In the current study, we examined only cases in which we had both child and parent-report data at baseline and at 5 years. Thus, outcome analyses for 5 year depression and anxiety (child self-report variable) included a sample of 242 subjects, and outcome analyses for 5 year inattention and conduct problems included a sample of 168 subjects. Independent t-tests, and chi square tests for nominal variables, were conducted to compare the children for whom we had complete data and those for whom we did not. Analyses on data missing at 5 year follow-up revealed that children did not significantly differ on demographic variables (e.g., SES, age, gender), nor did they differ on parent-report variables (i.e., attention problems, conduct problems; ps>0.05). However, children included in the 5 year follow-up analyses were more likely to have lower levels of depression at baseline (p=0.02) and at 5 years (p=0.03), though the magnitude of this difference (Cohens' d) was modest to small (ES=0.27, ES=0.16, respectively).

Results

Statistical Analyses

Descriptive statistics and preliminary Pearson correlation analyses were calculated to determine the univariate relations among study variables. There were significant relationships among study variables with a few exceptions. For instance, the only variable significantly correlated with age was 5 year anxiety. Additionally, 5 year anxiety and 5 year conduct problems were not significantly correlated (see Table 1). Given the overall sample included both problem and non-problem children; we tested the differences between the respective sub group correlations. Analyses using z-tests were conducted across sub-samples, revealing no significant differences in the magnitude of the correlations (p>0.05) between study variables. The data analysis that follows was conducted on the entire sample (problem and non-problem children).

A series of hierarchical linear regression analyses were conducted to test for main effects and the hypotheses that age or gender would moderate the relationship between baseline symptoms of depression, anxiety, conduct problems, inattention, and 5 year outcomes. Following guidelines on testing moderator models outlined by Jaccard and Turrisi (2003), predictor variables were entered in the following order: (1) main effects for all baseline symptoms, age, and gender; and (2) two-way interaction terms. To control for potential collinearity effects and test moderation effects with continuous variables, all main effect terms were standardized, and age was centered at the mean (9 years of age) prior to the creation of cross-product terms (Aiken and West 1991).

The results of the models evaluating the association between baseline levels of depression, anxiety, conduct problems, inattention, and 5 year outcomes for depression and anxiety are presented in Table 2. The association between baseline variables and 5 year outcomes for inattention and conduct problems are provided in Table 3. The main effects entered in step 1 accounted for significant model variance for each outcome variable. The significant results of analyses for two-way interactions predicting 5 year outcomes are summarized in step 2 of the corresponding table. Two-way interactions found to have significant simple slopes are graphically displayed in Figs. 1, 2, 3 and 4.

Predicting Depression

Main effects for both baseline inattention and baseline depression were found to predict symptoms of depression at 5 years. Baseline inattention had a positive relationship with depression at 5 years, t (235)=2.18, p<0.05. Baseline depression also had a positive relationship with 5 year

Table 1 Intercorrelations for Variables

Variable	1	2	3	4	5	6	7	8	9
Inattention	–	0.62**	0.42**	0.30**	0.80**	0.48**	0.28**	0.25**	0.08
Conduct Problems	0.62**	–	0.34**	0.27**	0.46**	0.61**	0.19**	0.17**	0.10
Depression	0.42**	0.34**	–	0.75**	0.38**	0.34**	0.37**	0.34**	−0.07
Anxiety	0.30**	0.27**	0.75**	–	0.36**	0.24**	0.30**	0.41**	0.00
5 year inattention	0.80**	0.46**	0.38**	0.36**	–	0.55**	0.33**	0.38**	0.04
5 year conduct problems	0.48**	0.61**	0.34**	0.24**	0.55**	–	0.22**	0.13	0.10
5 year depression	0.28**	0.19**	0.37**	0.30**	0.33**	0.22	–	0.65**	0.11
5 year anxiety	0.25**	0.17**	0.34**	0.41**	0.38**	0.13	0.65**	–	0.21**
Age at baseline	0.08	0.10	−0.07	0.00	0.04	0.10	0.11	0.21**	–

**p<0.01, * p<0.05

Table 2 Hierarchical Linear Regression Models Predicting 5 Year Outcomes for Depression and Anxiety

Variable	5 year depression (N=242)				
	R^2	$R^2\Delta$	B	SE	β
Step 1	0.16***	–			
Inattention			0.16	0.07	0.17*
Conduct			−0.03	0.07	−0.03
Depression			0.28	0.09	0.29**
Anxiety			0.01	0.08	0.01
Age			0.05	0.05	0.07
Gender			0.17	0.14	0.08
Step 2	Significant two-way interactions predicting depression				
Conduct×gender	0.18	0.02*	0.29	0.12	0.17*
Depression×age	0.17	0.01*	0.12	0.06	0.13*
Anxiety×age	0.19	0.03**	0.15	0.05	0.18**
N=242)					
Step 1	0.20***	–			
Inattention			0.15	0.07	0.16*
Conduct			−0.06	0.07	−0.06
Depression			0.07	0.09	0.07
Anxiety			0.30	0.09	0.31***
Age			0.14	0.05	0.16**
Gender			0.09	0.14	0.04
Step 2	Significant two-way interactions predicting anxiety				
Inattention×gender	0.21	0.02*	0.27	0.12	0.16*
Conduct×gender	0.23	0.03***	0.40	0.12	0.22***
Depression×age	0.21	0.02*	0.12	0.06	0.12*
Anxiety×age	0.22	0.02**	0.13	0.05	0.15**

Weights are derived from each step of the model. A significant change in R^2 was required to interpret significant coefficients. Main effects were sustained following inclusion of all interaction terms and therefore not further delineated. All two-way interactions were modeled separately.
***p<0.001, **p<0.01, *p<0.05

depression, t (235)=3.04, p<0.05. However, a significant depression×age interaction effect further modified the main effect of baseline depression, R^2 change=0.01, p<0.05. The simple slope for the depression×age interaction was significant for older children, but not younger children [older children: B=0.42, SE=0.11, t (235)=3.82, p<0.001; younger children: B=0.15, SE=0.11, t (235)=1.32, p=0.19]. Thus, older children with high levels of depression at baseline (depression at least 1 SD above the mean) exhibited higher levels of symptoms of depression 5 years later (see Fig. 1). In addition, there were two additional significant two-way interactions that predicted depressive symptoms 5 years later. First, a significant conduct×gender interaction effect was found to predict 5 year depression, R^2 change=0.02, p<0.05, indicating that baseline levels of conduct problems predicted depressive symptoms 5 years later differently for boys and girls. However, the simple slopes were not significantly different from zero. Additionally, a significant anxiety×age interaction predicted depression at 5 years, R^2 change=0.03, p<0.01. The simple slope was significant for older children, but not younger children [older children: B=0.22, SE=0.11, t (235)=1.96, p<0.05; younger children: B=−0.13, SE=0.09, t (235)=1.48, p=0.14]. Thus, older children with high levels of anxiety at baseline (anxiety at least 1 SD above the mean) exhibited higher levels of symptoms of depression 5 years later (see Fig. 1).

Predicting Anxiety

Baseline inattention, anxiety, and age produced main effects that were further modified by significant two-way interactions when the coefficients in step 2 were examined. The main effect for baseline anxiety predicting 5 year anxiety was modified by a significant anxiety×age interaction, R^2 change=0.02, p<0.05. In this case, the simple slopes for

Table 3 Hierarchical Linear Regression Models Predicting 5 Year Outcomes for Inattention and Conduct Problems

Variable	5 year Inattention (N=168)				
	R^2	$R^2\Delta$	B	SE	β
Step 1	0.66***	–			
Inattention			0.79	0.06	0.81***
Conduct			−0.06	0.06	−0.06
Depression			−0.05	0.08	−0.05
Anxiety			0.14	0.07	0.15*
Age			0.00	0.04	0.00
Gender			0.15	0.11	0.07
Step 2	Significant two-way interaction predicting inattention				
Conduct×gender	0.67	0.01*	0.29	0.14	0.12*
	5 year Conduct (N=168)				
Step 1	0.41***	–			
Inattention			0.11	0.08	0.11
Conduct			0.53	0.08	0.51***
Depression			0.29	0.11	0.26**
Anxiety			−0.15	0.09	−0.15
Age			0.05	0.06	0.06
Gender			0.08	0.15	0.03
Step 2	Significant two-way interactions Predicting Conduct				
Depression×age	0.43	0.02*	−0.14	0.07	−0.14*
Anxiety×age	0.43	0.02*	−0.14	0.06	−0.15*

Weights are derived from each step of the model. A significant change in R^2 was required to interpret significant coefficients. Main effects were sustained following inclusion of all interaction terms and therefore not further delineated. All two-way interactions were modeled separately.
***p<0.001, **p<0.01, *p<0.05

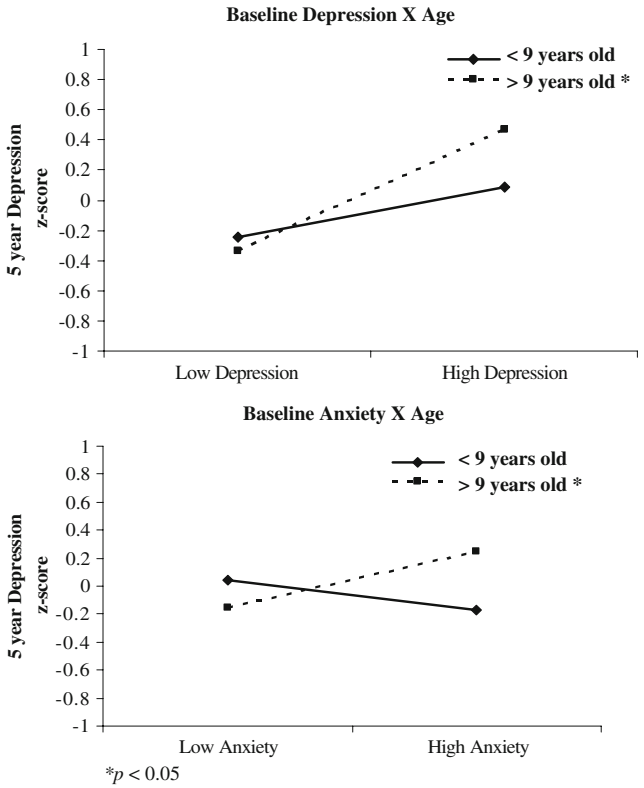

Fig. 1 Two-way age interaction predicting 5 year symptoms of depression

both older and younger children were found to be significantly different from zero [older children: B=0.46, SE=0.11, t (235)=4.16, p<0.001; younger children: B=0.19, SE=0.09, t (235)=2.11, p<0.05; see Fig. 2]. A significant inattention×gender interaction was found to predict 5 year Anxiety, R^2 change=0.02, p<0.05. The simple slope for girls, but not boys was found to be significantly different from zero [girls: B=0.33, SE=0.11, t (235)=3.16, p<0.01; boys: B=0.07, SE=0.08, t (235)=0.82, p=0.41], indicating that girls with higher levels of inattention at baseline had higher levels of anxiety 5 years later (see Fig. 3). Two additional significant two-way interactions were found to predict 5 year anxiety. The first, a significant conduct×gender interaction effect (R^2 change=0.03, p<0.001) indicated that the simple slopes for boys, but not girls was significantly different from zero when predicting 5 year levels of anxiety [boys: B=−0.19, SE=0.08, t (235)=2.24, p<0.05; girls: B=0.21, SE=0.11, t (235)=1.92, p=0.06]. Therefore, boys with higher levels of baseline conduct problems had lower levels of 5 year anxiety (see Fig. 3). Lastly, a significant depression×age interaction effect was found to predict anxiety 5 years later, R^2 change=0.02, p<0.01. However, the simple slopes in this analysis were not found to be significantly different from zero.

Predicting Inattention

Baseline levels of inattention had a significant main effect in relation to 5 year inattention, t (161)=13.17, p<0.001. Baseline anxiety was also a significant predictor of 5 year inattention [t (161)=1.99, p<0.05]. Only one two-way interaction was found to predict 5 year levels of inattention. Conduct×gender positively predicted levels of inattention at 5 years, R^2 change=0.01, p<0.05. However, the simple slopes in this analysis were not found to be significantly different from zero.

Predicting Conduct Problems

Baseline levels of conduct problems were positively associated with 5 year conduct problems, t (161)=6.41, p<0.001. Additionally, a main effect for depression was found to positively predict 5 year conduct problems. However, examination of the coefficients in step 2 of the model revealed that the main effect for baseline depression was modified by a two-way depression×age interaction, R^2 change=0.02, p<0.05. The simple slope was significant for children under the age of 9 years, but not significant for children over the age of 9 years [younger children: B=0.47, SE=0.13, t (161)=3.54, p<0.001; older children: B=0.14, SE=0.13, t (161)=1.02, p=0.31]. This indicates that children younger than 9 years of age exhibiting high levels of depression at baseline had a slight increase in conduct problems 5 years later (see Fig. 4). Lastly, a significant Anxiety×Age interaction was found to predict conduct problems 5 years later, R^2 change=0.02, p<0.05. The results indicated that the simple slope was significantly different from zero for older children, but not for younger children [older children: B=−0.35, SE=0.13, t (161)=−2.84, p<0.01; younger children: B=−0.02, SE=0.10, t (161)=−0.22, p=0.82]. Figure 4 shows that older children with low levels of anxiety at baseline have higher levels of conduct problems 5 years later.

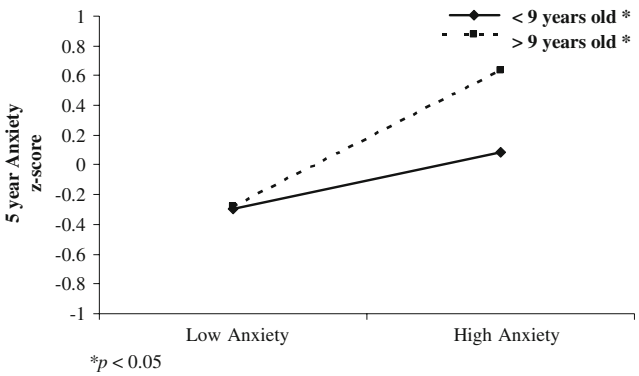

Fig. 2 Two-way interaction among baseline anxiety and age predicting 5 year symptoms of anxiety

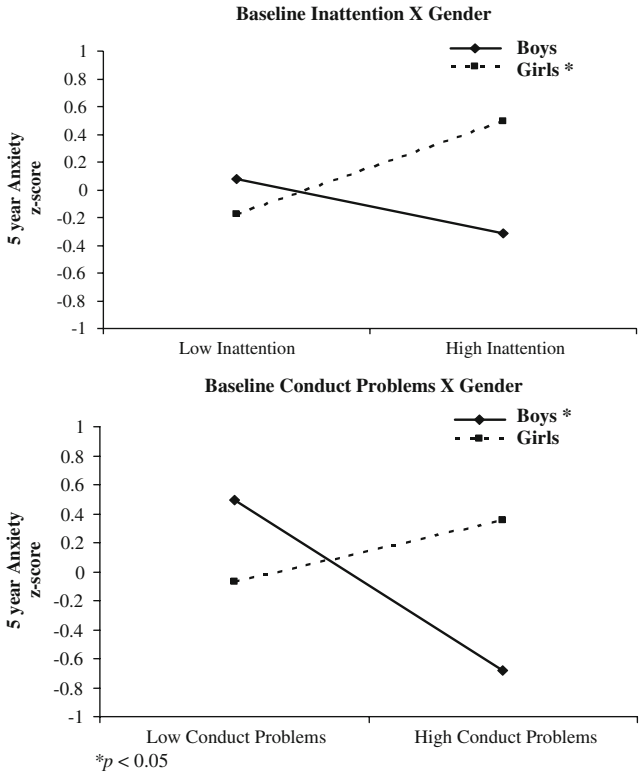

Fig. 3 Two-way gender interactions predicting 5 year symptoms of anxiety

Discussion

The present study examined the longitudinal relationships between depression, anxiety, and problems with conduct and attention, and the potential moderating effects of age and gender. As indicated by the strong relationships between baseline symptoms and 5 year outcomes for the same symptoms, there was clear evidence of homotypic continuity over time for all forms of psychopathology. We also found evidence of heterotypic continuity; in particular, one form of pathology (e.g., attention problems) consistently predicted a different form of pathology (e.g., depression) over the course of child and adolescent development. The findings also supported the expectation that the level of homotypic and heterotypic continuity varied with regard to age and gender. These findings will be discussed more fully in the sections that follow.

Predicting Depression

The temporal relationship between internalizing symptoms at baseline and later depression suggest that the homotypic continuity of internalizing symptoms emerged during the transition from later childhood to adolescence. Baseline anxiety and depression were unrelated to subsequent depression for younger children. These results are consistent with the notion that internalizing symptoms may be transient during early childhood; in contrast, for older children mood symptoms become more stable and may be linked to enduring genetic, cognitive, or social vulnerabilities (Cicchetti and Toth 1992). The findings are also consistent with the expectation that anxiety precedes depression (Avenevoli and Steinberg 2001; Brady and Kendall 1992; Roza et al. 2003); similarly, this temporal progression is most probable when anxiety symptoms are present between the later part of childhood and early adolescence.

Baseline inattention was a positive predictor of depressive symptoms 5 years later; moreover, this unique relationship was unaffected by overlapping psychopathology or the moderating effects of age and gender. Consistent with life course social field theory (Kellam et al. 1975), recent cross sectional research found that the heterotypic continuity of ADHD leading to depression is mediated by environmental and personal vulnerabilities. That is, symptoms of ADHD significantly interfere with young children's ability to adapt to the academic and social environment at school entry which undermines their sense of competence and places them at risk for future depressive symptoms. Negative transactions at home and school appear to mediate the relationship between ADHD and depression during early childhood; as childhood unfolds, related negative cognitions become a more proximal source of risk for depression (Herman and Ostrander 2007; Ostrander and Herman 2006; Ostrander et al. 2006).

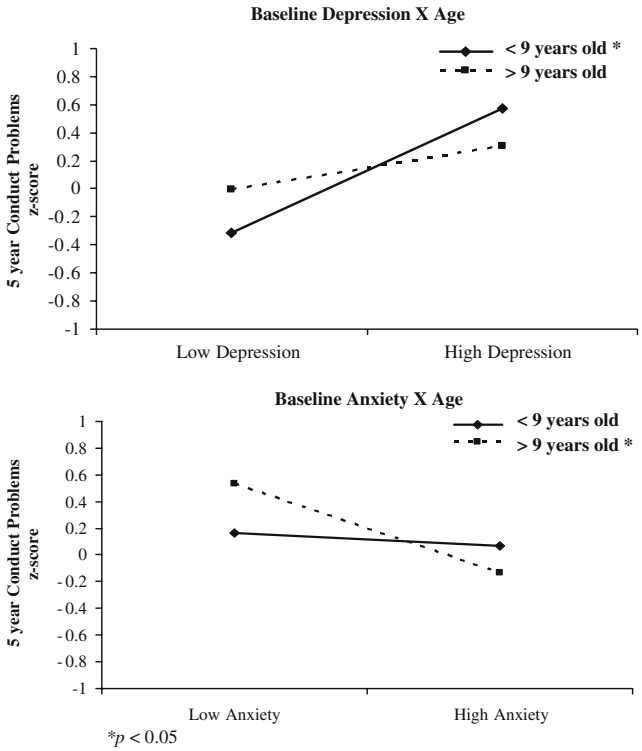

Fig. 4 Two-way age interactions predicting 5 year symptoms of conduct problems

Unlike prior research (Capaldi 1991; Offord et al. 1986) conduct problems did not pose a significant risk for later depression. Like prior studies (Offord et al. 1986), we found a significant interaction between gender and conduct problems in predicting 5 year depression; however, the analysis of simple slopes did not reveal a temporal relationship between early conduct problems and later depression specific to either gender. Methodological differences across studies help to explain discrepancies between the current study and the findings reported by others. For example, unlike prior studies the current study controlled for the overlapping effects of attention problems; as a result, the temporal relationship between conduct problems and later depression reported by others may have been due to both variables' shared and ignored relationship with inattention.

Predicting Conduct

Consistent with extensive prior research, conduct problems were positively associated with 5 year conduct problems, regardless of age or gender. We also found two interaction effects, suggesting that age moderated the unique temporal relationship between baseline anxiety and depression with later conduct problems. Older children with low levels of anxiety were more inclined to have increasing conduct problems as they made the transition into adolescence. Similar findings have been reported elsewhere and would suggest that a subset of children with conduct problems tend to display low levels of anxiety; however, this relationship is evident only when distortions are minimized by controlling for suppressor effects associated with ADHD (Frick et al. 1999).

Additionally a significant two-way age×depression interaction predicted 5 year conduct problems. The findings indicated that children under the age of nine with high levels of depression at baseline exhibited an increase in conduct problems at 5 years. These findings are similar to the findings by Kovacs and colleagues (1988) who found that depression increased the risk for developing later conduct problems. The authors from this study proposed that conduct problems develop as a complication of depression. Additional research is necessary to further delineate the critical periods during the transition from childhood to adolescence that allow for the developmental progression from depression to conduct problems**.** In any case, the current findings indicate that intervening with children under the age of 9 years showing signs of depression, regardless of gender, may be beneficial in decreasing future conduct problems. Signs of depression in young children may be an early warning that can be targeted in an effort to prevent the development of later, and often difficult to treat, conduct problems.

Other researchers have found that inattention contributes to increasing conduct problems overtime; similarly, the current study revealed pairwise correlations suggesting that attention problems are strongly associated with conduct problems 5 years later. However, the current study did not find the effects of inattention to be uniquely associated with later occurring conduct problems. It may be that the relationship between attention problems and conduct problems are accounted for by the effects of early disruptive behaviors that are already well established prior to entering elementary school (Hinshaw and Lee 2003). Thus, the critical developmental period whereby inattention has a direct effect on conduct problems may have occurred prior to the time frame of the current study.

Predicting Anxiety

Consistent with recent research (Costello et al. 2003), the most reliable predictor of anxiety over time was the level of baseline anxiety; however, there was greater stability in the level of anxiety for older children than for younger children. There was also evidence of heterotypic continuity. For example, attention problems in girls were predictive of subsequent anxiety; however, this relationship was not displayed in boys. Prior research has reported a strong relationship with early attention deficits and anxiety for both genders (e.g., Biederman et al. 1991; Jensen et al. 2001); however, this research has relied on diagnostic categories and did not control for concurrent pathologies at baseline.

Further, pairwise correlations revealed a modest positive correlation between baseline conduct problems and 5 year anxiety. However, multiple regression analysis indicated that the unique relationship between baseline conduct problems and later anxiety was not significant for females; interestingly, for males the relationship was reversed (i.e., negative). Thus, for males severe conduct problems at baseline was associated with low levels of anxiety 5 years later, a relationship that was unrelated to baseline anxiety, depression, inattention, and conduct problems. Some researchers have tested a developmental pathway in which the absence of anxiety or emotional reactivity may be an antecedent for severe conduct problems (Frick 2006), however, the current study suggests that it is more likely that this relationship is bidirectional. That is, individuals that fail to show anxiety are more likely to display increasing conduct problems; however, the presence of conduct problems is also likely to protect males from experiencing anxiety as they get older.

Predicting Attention Problems

Research examining the continuity of attention problems has typically relied on assessment methods that reflect the various iterations of the DSM. These studies have reported

that the prevalence of ADHD declines throughout the adolescent years; yet, the diagnostic imprecision associated with the DSM-IV nosology has led to questions concerning these findings (Barkley 2003). Using a continuous measure of attention problems, we found the level of inattention was remarkably stable and the level of stability was not moderated by age or gender. We also found a unique heterotypic relationship between baseline anxiety and later attention problems. Interestingly, some researchers have identified a subset of children diagnosed with ADHD (i.e., sluggish cognitive tempo) that have attention problems along with anxiety (Barkley 2003). The current study may help clarify the developmental progression of this constellation of symptoms; in particular, some of the inattention experienced by children with ADHD may stem from anxiety. However, the current study suggests that attention problems do not typically emanate from other forms of psychopathology; to the contrary, attention problems are present early in childhood and remain remarkably stable through early adolescence.

Limitations

While this study provides valuable insight into the heterotypic and homotypic relationships between continuity of symptoms of problem behavior, the use of a dimensional approach limits the degree to which it can be conferred upon relationships between diagnostic categories. However, the use of categorical diagnostic constructs is limiting and can result in the loss of valuable information about continuity and discontinuity because those who score just below the diagnostic cutoff are considered non-cases. The dimensional approach solves this problem and allows for identification of co-occurrence of symptoms across time for individuals in the study. Thus, dimensional approaches to the study of symptom and disorder co-occurrence serve as a useful complement to research using categorical diagnostic approaches (Caron and Rutter 1991; Klein and Riso 1993).

A strength of the current study includes its large community sample of subjects displaying a range of psychopathology. Most prior studies have relied on cross sectional analyses of data of children from clinical samples. Clinical samples may not be representative of all children with these problems. Clinical samples typically have higher rates of comorbidity and more severe symptoms than community samples. Consistent with the recruitment approach in the present study, Caron and Rutter (1991) recommended conducting research with community samples for a more accurate depiction of characteristics associated with co-occurring conditions.

It is important to note, though, that community-based rather than clinical-referred samples also come with some limitations. It is unclear, for instance, whether the findings in the present study are applicable to children found in clinical practice. Also, some attrition occurred between baseline and 5 year follow-up, reducing the generalizability of findings. In particular, children with parent report information at 5 years were less depressed at baseline, limiting the applicability of the findings when interpreting the findings to 5 year conduct problem and inattention for children with higher levels of depression. In addition, the population selected for the present study was predominantly Caucasian, male, and middle class, another limit on the generalizability of the findings. Also, the 5 year lag between baseline and follow-up may not have been optimal for pinpointing precise pathological processes operating over time. Therefore, future research interested in mediating variables or further understanding the co-occurrence of symptoms over time should consider multiple data collection periods over shorter time intervals.

Because our sample was recruited from the community, the referral bias associated with clinic samples did not play a role in our findings. However, by over-sampling children based on extreme scores on the Conners, we increased our power to detect interaction effects. There are notable advantages to this approach. As noted by McClelland and Judd (1993), with this approach, the parameter estimates in the moderated regression model remain unbiased; moreover, those estimates have smaller standard errors and hence narrower confidence intervals. Nevertheless, this sampling approach may inflate the overall variance explained by the model. This would be a serious limitation if our primary intent was to estimate the total variance explained by the moderation model (McClelland and Judd 1993; Whisman and McClelland 2005). However, one of the central aims of the current study was to determine whether age or gender interacted with various forms of psychopathology to predict changes in pathology over time; and under these conditions, oversampling has been recommended as the preferred approach (Cohen et al. 2003; McClelland and Judd 1993; Whisman and McClelland 2005).

Prevention and treatment programs are needed to target the patterns and emergence of co-occurring symptoms or disorders. Rather than focusing on preventing or intervening in singular disorders, a new generation of research is needed that targets the prevention of comorbidities. After identifying the heterotypic and homotypic continuity and discontinuity of symptoms and disorders, prevention and treatment programs may be able to use the information to increase early identification and to target malleable factors for reducing the risk. Undoubtedly, childhood psychopathology is a complex phenomenon, requiring attention to the interactive effects of development and gender. In sum, the findings suggest the need for treatments and prevention programs that both recognize homotypic and heterotypic

continuity in symptoms and understand how gender and/or developmental considerations moderate this process.

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