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Bidirectional Linkages between Emotion Recognition and Problem Behaviors in Elementary School Children

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Abstract

Cross-sectional studies support negative associations between children's skills in recognizing emotional expressions and their problem behaviors. Few studies have examined these associations over time, however, precluding our understanding of the direction of effects. Emotion recognition difficulties may contribute to the development of problem behaviors; additionally, problem behaviors may constrain the development of emotion recognition skill. The present study tested the bidirectional linkages between children's emotion recognition and teacher-reported problem behaviors in 1st and 3rd grade. Specifically, emotion recognition, hyperactivity, internalizing behaviors, and externalizing behaviors were assessed in 117 children in 1st grade and in 3rd grade. Results from fully cross-lagged path models revealed divergent developmental patterns: Controlling for concurrent levels of problem behaviors and first-grade receptive language skills, lower emotion recognition in 1st grade significantly predicted greater internalizing behaviors, but not hyperactivity or externalizing behaviors, in 3rd grade. Moreover, greater hyperactivity in 1st grade marginally predicted lower emotion recognition in 3rd grade, but internalizing and externalizing behaviors were not predictive of emotion recognition over time. Together, these findings extend previous research to identify specific developmental pathways, whereby emotion recognition difficulties contribute to the development of internalizing behaviors, and early hyperactivity may contribute to the development of emotion recognition difficulties, thus highlighting the importance of examining these processes and their mutual development over time.

Keywords

emotion recognition; hyperactivity; internalizing behaviors; longitudinal design; children

Children who demonstrate problematic behaviors in the classroom, such as hyperactivity, internalizing behaviors, and externalizing behaviors, also typically experience interpersonal difficulties. These difficulties are thought to relate to under- or over- awareness of one's own or others' emotions, inaccurate identification of emotional expressions, and unreasonable interpretations as to why others feel the way they do (Casey 1996; Saarni 1999; Singh et al. 1998; Walker and Leister 1994). Children who struggle to accurately identify how others are feeling may be hampered in their ability to effectively communicate and interact with others (Halberstadt, Denham, and Dunsmore 2001). These children may develop problem behaviors over time, as they become frustrated with their emotionally misaligned communication skills and/or respond inappropriately to others' misperceived emotions (Crick and Dodge 1994). At the same time, children who demonstrate problematic behaviors in the classroom may develop poor emotion recognition skills given limited opportunities to practice these skills with others—including with peers who might avoid, minimize, or modify interactions with a challenging child—thus, constraining potential advancement of emotion recognition skills over time (Boyatzis and Satyaprasad 1994). Given these reciprocal pathways, assessing directionality of these linkages enables us to better understand the etiology of problem behaviors and may also help guide intervention programs aimed at promoting children's socioemotional competence.

A major hindrance to our understanding of directionality is the limited number of studies assessing both emotion recognition and problem behaviors over time. Indeed, most studies utilize a cross-sectional design. The few extant longitudinal studies generally confirm that children with lower emotion recognition skills exhibit more problem behaviors over time (e.g., Chronaki, Hadwin, Garner, Maurage, and Sonuga-Barke 2015; Strand, Cerna, and Downs 2008; Székely et al. 2014), but causal implications are constrained by methodological differences and limitations across studies. Specifically, in previous research: (1) different *ages* were examined across studies, and thus differences in results may reflect differences in developmental periods, (2) different *problem behaviors* were examined across studies, precluding integration of findings across behaviors, and (3) developmental linkages were examined only partially, as no study has yet utilized a *fully balanced longitudinal design* including both emotion recognition and problem behaviors at multiple time points. Thus, a gap remains in our understanding of the ways in which emotion recognition skills and problem behaviors—specifically, hyperactivity, internalizing behaviors, and externalizing behaviors—develop reciprocally.

The present study addressed this gap by testing the bidirectional linkages between children's emotion recognition skills and teacher-reported hyperactivity, internalizing behaviors, and externalizing behaviors in 1st and 3rd grade. We begin by defining emotion recognition and describing the normative processes in developing emotion recognition from early to middle childhood, emphasizing why this period is also relevant to the development of problem behavior. We then explicate the hypothesized linkages between emotion recognition and hyperactivity, internalizing behaviors, and externalizing behaviors in early and middle childhood.

Emotion Recognition among Elementary-School-Age Children

Emotion recognition is defined as the subset of skills involved in attending to, identifying, and labeling facial, bodily, and vocal expressions of emotion displayed by the self or others (Castro, Cheng, Halberstadt, and Grün 2016; Denham 1986; Halberstadt et al. 2001; Harris 1989). Emotion recognition is an important component of children's socioemotional competence, as children learn how to recognize emotions in others and subsequently use this information to inform and guide their own emotional experiences and behaviors when interacting with others (Halberstadt et al. 2001).

Emotion recognition skills develop rapidly during the first years of life (Walker-Andrews 1986), and children are typically capable of observing an emotional expression and matching this expression with a given emotional label by the age of 5 (Denham 1986; Harris 1989; Pons, Harris, and de Rosnay 2004). As children mature, they become more cognizant of emotional expressions that are less prototypical and instead include multiple, mixed, and fragmented emotional cues (Camras, Castro, Halberstadt, and Shuster 2017; Halberstadt, Parker, and Castro 2013; Larsen, To, and Fireman 2007). To accurately interpret these complex emotional displays, children must continue to develop their emotion recognition skills over time and across contexts (Pons et al. 2004) and practice their skills as they interact with family members, teachers, and peers. Development of these skills continues to be important in middle childhood, as demonstrated through associations with peer relations and social competence in elementary school (for reviews, see Halberstadt et al. 2001; Trentacosta and Fine 2010).

Emotion Recognition and Problem Behaviors: Which Comes First?

We focus on *problem behaviors* given the broad interest among researchers, clinical practitioners, parents, and educators in identifying the prevalence, course, and correlates of behavior problems across childhood (e.g., Campbell 1995; Glascoe, MacLean, and Stone 1991). Moreover, the specific problem behaviors of *hyperactivity*, *internalizing behaviors*, and *externalizing behaviors* are the most widely studied in relation to elementary-school-age children's emotion recognition skills (Trentacosta and Fine 2010).

Hyperactivity/Inattention

Hyperactivity has often been defined with regard to two facets: attentional control and behavioral regulation (e.g., Henker and Whalen 1999; Martel 2009). These facets can manifest as being easily distracted, acting impulsively, or being disruptive (Gresham and Elliot 1990). In childhood, hyperactivity has been associated with poor social skills and peer relationships (e.g., Duncan et al. 2007; Garner and Waajid 2012; Sawyer, Miller-Lewis, Searle, Sawyer, and Lynch 2015), and these negative associations persist well into adolescence (Taylor, Chadwick, Heptinstall, and Danckaerts 1996).

Associations between emotion recognition and hyperactivity are likely, given underlying linkages among their core emotional, attentional, and behavioral regulatory processes, which act in concert to promote adaptive functioning (Calkins and Dedmon 2000; Eisenberg et al. 1996; Fabes, Eisenberg, Karbon, Troyer, and Switzer 1994). Indeed, negative associations

between emotion recognition and hyperactivity (measured as either inattention or lack of behavioral regulation) have been reported in three studies assessing these variables concurrently in children between the ages of 3 and 6 (Chronaki et al. 2015; Garner and Waajid 2012; Rhoades, Warren, Domitrovich, and Greenberg 2011). We thus expected negative associations between emotion recognition and hyperactivity in 1st and 3rd grade.

However, cross-sectional findings cannot tease apart unique directional effects from the concurrent linkages. With regard to directional effects, it seems plausible that poor emotion recognition skills could worsen inattentiveness to or impulsiveness with peers and adults over time. If children have insufficient skills with which to notice important changes in others' facial, bodily, and vocal cues, they may avoid or miss opportunities to attend to and process these external cues and may consequently activate inappropriate self-regulatory behaviors. Alternatively, children experiencing problems with attention and self-regulation may be unable to direct and maintain attention towards emotional stimuli, which might result over time in decrements to emotion recognition development. Strains on attentional processes likely interrupt the ability to accurately recognize, process, and interpret emotional displays (Phillips, Tunstall, and Channon 2007). Indeed, in order to recognize an emotional display, one must first be aware that an emotional message was communicated (Castro, Cheng, et al. 2016; Halberstadt et al. 2001).

Only two studies have tested these associations longitudinally, providing partial and preliminary support for their mutual development. In one study, lower emotion recognition at age 5 predicted greater hyperactivity four years later (Izard et al. 2001). In a second examination of the same population, the inverse pathway was supported: greater hyperactivity in 5-year-olds predicted lower emotion recognition two years later, albeit weakly (Schultz, Izard, Ackerman, and Youngstrom 2001). Given these findings, we expected that children's hyperactivity and emotion recognition would be mutually associated over time.

Internalizing behaviors

Internalizing behaviors are broadly characterized as negative thoughts and behaviors that individuals direct toward themselves (Eisenberg et al. 2001). Common markers for internalizing behaviors include anxiety, withdrawal from social situations, depression, and loneliness (Campbell 1995; Gilliom and Shaw 2004). These behaviors increase with age as children develop cognitive abilities that allow them to better remember and anticipate negative events (Gilliom and Shaw 2004; Trembley et al. 1996), to engage in social comparisons (Pomerantz, Ruble, Frey, and Greulich 1995), and to develop more stable self-concepts of themselves as individuals who are not comfortable with social contexts (Harter 2006).

Associations between emotion recognition difficulties and internalizing behaviors are thought to reflect shared behavioral and neurological dysfunctions (Lenti, Giacobbe, and Pegna 2000; McClure and Nowicki 2001), including a breakdown in the quality and quantity of social interactions. This perspective is supported in part by four studies that revealed negative concurrent associations between emotion recognition and internalizing behaviors in preschoolers, as well as first-graders (Fine, Izard, Mostow, Trentacosta, and Ackerman 2003;

Heinze, Miller, Seifer, Dickstein, and Locke 2015; Strand, Cerna, and Downs 2008; Székely et al. 2014). Another study with 8- to 10-year-olds, however, found a weak but *positive* association between emotion recognition and social anxiety, with only one of the four tests of emotion recognition achieving significance (McClure and Nowicki 2001). Together, these findings suggest that cross-sectional associations between emotion recognition and internalizing behaviors may shift in strength as children age. Consequently, we expected a negative association between emotion recognition and internalizing behaviors in 1st grade only.

With regard to directional effects, previous research supports the possibility that emotion recognition difficulties contribute to subsequent internalizing behaviors. A child who misperceives a peer's neutral expression as anger, or who misreads genuine invitations to engage with others as insincere, may withdraw from the situation, missing not only the opportunity to interact with their peers, but also any potential feedback they may receive regarding their emotion recognition errors. This pathway may result in continued situational avoidance and social withdrawal, which likely begets continued uncertainty and inaccuracy in recognizing others' emotions (McClure and Nowicki 2001; Nowicki and Duke 2001). Although one study with 3- to 5-year-old children failed to find significant short-term longitudinal effects (Strand et al. 2008), two other studies with slightly older children and a longer longitudinal period supported this directional pathway. Specifically, lower emotion recognition at age 5 predicted greater internalizing behaviors at age 9 (Izard et al. 2001), and lower emotion recognition at age 7 predicted greater levels of loneliness and anxiety—developmentally-appropriate indicators of internalizing behaviors—at age 11 (Fine et al. 2003).

Less likely, albeit plausible, is the inverse pathway: Children who remove themselves from social situations or who are so anxious that emotion recognition is likely impaired by arousal, might fail to improve their emotion recognition skills over time. Two studies that tested the extent to which internalizing behaviors inhibit the development of emotion recognition over time provided only minimal support for this pathway. One study found that internalizing behaviors at 18 months did not predict emotion recognition at 36 months (Székely et al. 2014), and another study found that internalizing behaviors in 3- to 5-year-old children were associated with lower emotion recognition skills for only one of two emotion recognition tasks six months later (Strand et al. 2008).¹

Collectively, these findings provide greater support for the impact of early emotion recognition difficulties on the development of later internalizing behaviors than vice versa in elementary-school-age children. Thus, we expected children with lower accuracy in recognizing others' emotions in 1st grade to exhibit greater internalizing behaviors in 3rd grade, given the stronger evidence for this directional pathway.

¹These divergent findings may reflect the use of different emotion recognition measures depicting facial vs. non-facial (i.e., schematic) expressions. However, children's performance levels were similar across measures and did not reach ceiling levels in either measure.

Externalizing behaviors

Externalizing behaviors are broadly defined as negative behaviors directed toward the external environment (Campbell, Shaw, and Gilliom 2000; Eisenberg et al. 2001; Liu 2004) and include disobeying rules, vandalism, threatening others, physical aggression, and other forms of violence. Externalizing behaviors can progress into more serious behavioral problems and disorders across childhood, including antisocial behaviors and conduct problems (Campbell et al. 2000; McGue and Iacono 2005).

Theoretical perspectives suggest that emotion recognition skill and externalizing behaviors are correlated, as the same underlying processes simultaneously foster both difficulty in recognizing others' emotional cues and externalizing behaviors (Blair 1995; Lemerise and Arsenio 2000). For example, when externalizing behaviors emerge as a consequence of emotional distress, it is likely that the emotional distress reduces both the regulatory inhibitions that prevent externalizing behaviors as well as overwhelm any skill at judging what others are feeling (Calkins and Dedmon 2000; Eisenberg et al. 1996). Cross-sectional findings from three studies generally support negative associations between emotion recognition skill and externalizing behaviors in children between the ages of 18 months and 7 years, with the strongest effects observed for children ages 3 to 6 (Chronaki et al. 2015; Fine et al. 2003; Székely et al. 2014). Thus, we expected to replicate these cross-sectional associations in 1st and 3rd grade.

With regard to directional effects, the evidence is less clear. When children misinterpret others' emotion-related cues, they may see more reason to become aggressive (Schultz, Izard, and Bear 2004), and this inaccurate feedback may promote inappropriate social behavior (Crick and Dodge 1994). However, the one study that tested this hypothesis found that emotion recognition at age 5 did not predict later externalizing behaviors at age 9 (Izard et al. 2001). Alternatively, externalizing behaviors may impede the development of emotion recognition. Engaging in large motor activities such as threatening, shouting, or fighting might preclude the attention needed to recognize others' emotions, and, over time, high externalizing children may not develop the skills necessary to look at and interpret others' emotions. Consistent with theoretical models of social information processing (Crick and Dodge 1994; Malone, Carroll, and Murphy 2012), externalizing children may experience difficulty in encoding and interpreting others' emotional signals and, as a result, experience difficulty in selecting and enacting appropriate responses to a given situation, thus reinforcing their externalizing behavior (Lemerise and Arsenio 2000). However, the one study testing longitudinal effects with very young children found no association between externalizing behaviors at 18 months and children's abilities to label emotional expressions at 36 months (Székely et al. 2014).

Because it is not empirically or theoretically clear whether emotion recognition inaccuracies contribute to externalizing behaviors or externalizing behaviors contribute to emotion recognition inaccuracies, we thought it important to explore both of these directionalities. In the context of such sparse significant directional findings in the extant literature, however, we made no specific longitudinal predictions.

The Present Study

To explore concurrent and directional linkages between emotion recognition and hyperactivity, internalizing behaviors, and externalizing behaviors, we tested a series of cross-lagged path models that estimated the cross-associations between children's emotion recognition and problem behaviors in 1st and 3rd grade, while accounting for stability in each construct over time. Our study, therefore, extends previous work in three important ways. First, unlike previous studies, our study employed a fully balanced longitudinal research design that assessed the linkages between emotion recognition and problem behaviors across a two-year period spanning early and middle childhood. From a developmental perspective, it may be especially important to examine these linkages beyond early childhood, because of continued growth in emotion recognition (Nowicki and Duke 1994; Pons et al. 2004), attention (Olson, Sameroff, Kerr, Lopez, and Wellman 2005; Posner and Rothbart 2000), and behavioral regulation (Rafaelli, Crockett, and Shen 2005). Second, we utilized cross-lagged path models to test for the directionality of effects. Third, we tested concurrent and cross-lagged associations while controlling for the effects of child receptive language skill and gender, as past research indicates that boys and children with low receptive language skill tend to demonstrate lower emotion recognition skill and more problem behaviors than girls and children with high receptive language skill (Sette, Bassett, Baumgartner, and Denham 2015; Strand, Downs, and Barbosa-Leiker 2016; von Salisch, Haenel, and Denham 2015; von Salisch, Haenel, and Freund 2013).

Consistent with previous cross-sectional research, we predicted significant concurrent associations between children's emotion recognition and hyperactivity, internalizing behaviors, and externalizing behaviors in 1st grade and between children's emotion recognition and hyperactivity and externalizing behaviors in 3rd grade. Given past research, we did not expect concurrent associations between emotion recognition and internalizing behaviors in 3rd grade.

Drawing upon theory and empirical results, we hypothesized that lower emotion recognition skills in 1st grade would predict greater hyperactivity in 3rd grade, and greater hyperactivity in 1st grade would predict lower emotion recognition skills in 3rd grade. We also hypothesized that lower emotion recognition skills in 1st grade would predict greater internalizing behaviors in 3rd grade, but not vice versa. We made no predictions regarding the cross-lagged associations between emotion recognition and externalizing behaviors in 1st and 3rd grade, given contrasting theoretical and empirical perspectives.

Method

Participants

Participants were 117 children (70 African American, 44 European American, and 3 Biracial; 53.8% female) and their first- and third-grade teachers. Children were part of the Durham Child Health and Development Study, a longitudinal study assessing child development from 3 months to 3rd grade in families living in and around a midsized southeastern city. Inclusion in this sample was dependent upon children having participated in both first- and third-grade assessments. Children were on average 6 years ($SD = 0.44$) and

8 years ($SD = 0.26$) old in 1st and 3rd grade, respectively. Families in this sample represented a range of total household income (\$800 to \$420,000 in 3rd grade, *Median* = \$81,000) and maternal education levels (measured in 3rd grade; range: 9th grade to some college education, *Median* = some college education).

Measures

Covariates—Child gender and receptive language ability were included as covariates in our predictive model. The inclusion of these covariates is consistent with past research examining the links between children's emotional skills and their problem behaviors (e.g., Sette et al. 2015; Strand et al. 2016; von Salisch et al. 2013, 2015). Moreover, both gender and receptive language skill are associated with emotion recognition, such that emotion recognition skill is typically higher for girls (Hall, Gunnery, and Horgan 2016) and for children with greater receptive language skill (Strand et al. 2016). Thus, the inclusion of gender and receptive language skill as covariates in our model allows for a more stringent test of the bidirectional linkages between emotion recognition and problem behaviors.

Children completed the Peabody Picture Vocabulary Test (PPVT-III; Dunn and Dunn 2007) in 1st grade as a measure of receptive language ability. Receptive vocabulary is an important indicator of children's cognitive and linguistic development (Dunn and Dunn 2007). The PPVT-III contains four training items followed by 17 sets of 12 test items each. Each item has four simple, full-color illustrations on a page arranged in a multiple-choice format. The child's task was to select the picture that best illustrated the meaning of a stimulus word presented orally by the research assistant. The PPVT-III has demonstrated good test-retest reliability and internal consistency with elementary-school-age children (Dunn and Dunn 2007).

Emotion recognition—In 1st grade, children completed the emotion recognition subtest of the Assessment of Children's Emotion Scale (ACES; Schultz and Izard 1999). This subtest consists of 17 color photographs of children's facial expressions. The subtest includes two prototypical facial expressions for each of four emotions (happy, sad, mad, and scared), five ambiguous facial expressions, and four neutral facial expressions. Children were asked to indicate if the child in the picture was feeling happy, sad, mad, scared, or not feeling anything at all. Emotion recognition accuracy was the average number of correctly identified discrete emotional facial expressions (out of the eight emotion facial expressions)². Accuracy scores for the ACES ranged from 0 to 1; see Table 1 for descriptive statistics. Because children were presented with five response options, chance accuracy level for the ACES task was .20; scores above this level indicate better than chance level accuracy, and higher scores indicate more accurate emotion recognition.

Reliability for the ACES task was weak by general standards (Kuder-Richardson Formula 20 = 0.55), but acceptable for this type of nonverbal perception task given the small number of items (Schlegel, Boone, and Hall 2017) and comparable with other studies employing the

²The neutral and ambiguous expressions are used to calculate attributional biases, or the tendency to attribute an emotion to a non-emotional or ambiguous display. These faces are, thus, not included in the calculation of emotion recognition accuracy for the ACES task.

ACES task (e.g., Domitrovich, Cortes, and Greenberg 2007; Schultz et al. 2004). Importantly, the ACES has demonstrated good evidence of construct validity in diverse samples of elementary-school-age children (Domitrovich et al. 2007; Schultz et al. 2004) and through associations with social skills (Mostow, Izard, Fine, and Trentacosta, 2002) and emotionality (Schultz et al. 2004).

In 3rd grade, children completed the Increasingly Clear Emotions task (ICE; Halberstadt, Lozada, Leary, Sibley, and Garrett-Peters 2010). The ICE is a computer-based task that includes video-recorded facial expressions of 20 different adult actors each expressing one of five discrete emotions (anger, sadness, happiness, fear, and surprise), with equal representation of African American and European American male and female actors. Thirteen expressions were chosen from the Extended Cohn-Kanade AU-Coded Facial Expression Database (Lucey et al. 2010) and seven were additionally recorded. Expressions unfold in seven rounds, from the very initial forming of the expression (first round) to the full, prototypical facial expression (final round), with all 20 posed facial expressions represented within each round. Children saw the four intermediary rounds that depict the facial expressions as they became clearer, resulting in a total of 80 expressions. Figure 1 illustrates the progression of the facial expressions across the four rounds. Children saw the round with the least amount of information first, then each subsequent round provided increasing amounts of information. Within each round, the facial expressions were presented in a new random order. After viewing each expression, children indicated on the computer whether the person in the video was feeling happy, angry, sad, fearful, or surprised. Accuracy was the average of correct emotion identifications across all 80 emotional expressions, resulting in potential accuracy levels between 0 (no accuracy) and 1 (perfect accuracy; for descriptive statistics, see Table 1). Given that children selected their responses from a provided list of five emotion labels, chance level accuracy for the ICE task was .20. Scores above .20 indicate greater than chance recognition accuracy, and higher scores indicate more accurate emotion recognition.

Reliability for the ICE task in this sample (Kuder-Richardson Formula 20 = 0.64) was relatively high compared to other measures of nonverbal emotion recognition (Schlegel et al. 2017), and construct validity for this task with elementary-school age children is shown through positive associations with other measures of emotion recognition and measures of emotion knowledge (Castro, Halberstadt, and Garrett-Peters 2016).

Although it might seem ideal to administer the same measure across time points, a more important consideration is conceptual continuity. Because the ICE task depicts a greater number of discrete emotions and expressions that vary in emotional information from little emotion to more prototypical emotion, it is a more developmentally appropriate task for 3rd grade children who are more advanced in their ability to recognize emotions (Harris 1989; Pons et al. 2004) than the ACES task. The ICE task also includes facial expressions posed by both African American and European American actors, providing a more ethnically diverse assessment that better matches the sample under study and enhances ecological validity. Given evidence of in-group advantages in emotion recognition (Elfenbein 2013; Elfenbein and Ambady 2002), it is important to include diverse and representative stimuli to ensure accurate performance assessments. Collectively, these differences confer clear

advantages in maintaining conceptual continuity for our measurement of emotion recognition, which is an integral goal for developmental assessments of nonverbal skills.

Problem behaviors—Children’s first- and third-grade teachers rated children’s hyperactivity, internalizing behaviors, and externalizing behaviors using the Social Skills Rating System for Teachers (SSRS-T; Gresham and Elliot 1990). This 55-item inventory assesses teachers’ perceptions of children’s social skill and problem behavior in the school setting. For the present study, we focused on the three commonly reported problem behavior subscales: Hyperactivity (6 items, “Is easily distracted”), Internalizing Behaviors (6 items, “Appears to be lonely”), and Externalizing Behaviors (6 items, “Fights with others”). Teachers rated children on each item using 3-point scales (0 = *never*, 1 = *sometimes*, and 2 = *very often*). Scores were averaged across items within each subscale. Descriptive statistics are presented in Table 1. Reliability (Cronbach’s α) in our sample ranged from .81 to .93 across all subscales across time points. Evidence of test-retest reliability and construct validity is provided in numerous studies (e.g., Burchinal, Roberts, Zeisel, and Rowley 2008; Gresham and Elliott 1990), as well as invariance for African American and European American populations (Decker, Dona, and Christenson 2007).

Procedure

Families were recruited through fliers and postings at birth and parenting classes, local shopping centers, as well as phone contact via birth records. Children and their families had participated in nine visits prior to 1st grade, and informed consent and assent from mothers and children respectively were collected at each time point. In 1st grade, children completed the ACES and the PPVT, with the assistance of trained research assistants who read the items aloud. In 3rd grade, children completed the ICE task on a computer with research assistants nearby to assist children as needed. At both time points, research assistants watched and aided closely to facilitate children’s maintenance of focus on the tasks as needed. Both lab visits averaged about two hours in duration, with a snack break in the middle. At both visits, mothers were compensated for their time and travel, and children received a toy from a treasure box. Following each lab visit, the SSRS-T was mailed to the teachers of each child whose mothers provided the teacher contact information. Teachers were compensated for their time.

Results

Children’s hyperactivity, internalizing behaviors, and externalizing behaviors in 1st and 3rd grade were moderately positively skewed. These data were transformed using the square-root transformation (Tabachnick and Fidell 2007), and the transformed variables were used in all subsequent analyses. Following these transformations, assumptions of univariate and bivariate normality were met.

Preliminary Analyses

Correlations between children’s emotion recognition skill and problem behaviors were conducted within and across time points (see Table 2). As expected, emotion recognition was significantly negatively associated with all three problem behaviors in 1st grade.

However, and contrary to our expectations, concurrent associations between emotion recognition and problem behaviors were non-significant in 3rd grade.

Associations also varied across time. Consistent with our predictions, there was a significant negative association between emotion recognition in 1st grade and internalizing behaviors in 3rd grade. Moreover, we found a significant negative association between hyperactivity in 1st grade and emotion recognition in 3rd grade. However, no other longitudinal associations were significant; emotion recognition in 1st grade was unrelated to hyperactivity and externalizing behaviors in 3rd grade, and internalizing behaviors and externalizing behaviors in 1st grade were unrelated to emotion recognition in 3rd grade.

Associations with children's receptive language ability and gender generally reflected previous findings: Children with greater receptive language skill in 1st grade tended to have greater emotion recognition skills in 1st grade and fewer problem behaviors in 1st and 3rd grade; boys were more likely than girls to be rated by teachers as displaying problem behaviors in 3rd grade. Receptive language ability was not significantly correlated with child gender. We included child language ability and gender as independent covariates in subsequent path models (see Figure 2).³

Cross-lagged Path Models

To test the bidirectional linkages between children's problem behaviors and emotion recognition across time points while accounting for concurrent associations within each time point and stability in each construct over time, we estimated a series of path models with cross-lagged effects using Mplus version 7.4 (Muthén and Muthén 1998–2015). Given our interests in identifying unique developmental pathways, separate models were estimated for hyperactivity, internalizing behaviors, and externalizing behaviors.

Missing data occurred an average 18% across measures and time points and were due mainly to unreturned teacher questionnaires in 1st grade (35–37%) and 3rd grade (22%). Children with missing teacher data in 1st grade tended to also have missing teacher data in 3rd grade ($r = .25, p = .006$). Children with missing teacher data at 1st grade tended to have greater levels of externalizing behaviors at 3rd grade ($r = .28, p = .008$) but did not vary in their levels of hyperactivity or internalizing behaviors at 3rd grade compared to children with complete data ($ps = .267-.818$). Moreover, children with missing teacher data at 3rd grade did not vary in their levels of hyperactivity, internalizing behaviors, or externalizing behaviors at 1st grade compared to children with complete data ($ps = .295-.691$). Children with missing teacher data (at either time point) did not vary in their levels of emotion recognition (at either time point) compared to children with complete data ($ps = .368-.789$). Missing data were also unrelated to maternal education level ($ps = .132-.397$) and to child gender and ethnicity ($ps = .174-.724$). To address the single significant difference between children with missing vs. complete data, missing data were estimated using maximum likelihood estimation.

³We followed reviewers' suggestions to explore child ethnicity as a potential covariate. We found that African American children received higher ratings of externalizing behaviors than European American children at both time points. However, a path model with child ethnicity entered as a covariate revealed no significant unique effects of child ethnicity on 1st and 3rd grade externalizing behaviors. Thus, we omitted child ethnicity as a covariate in subsequent models. For full exploratory results, see Appendix.

Model fit was determined using the chi-square statistic (χ^2), Comparative Fit Index (CFI), Tucker-Lewin Index (TLI), Root Mean Square Error of Approximation (RMSEA), 90% confidence interval around RMSEA (90% CI), and the Standardized Root Mean Square Residual (SRMR). Good model fit to the data is generally represented by a non-significant χ^2 value, CFI and TLI $\geq .95$, and RMSEA and SRMR $\leq .08$ (Hu and Bentler 1999; Schreiber, Nora, Stage, Barlow, and King 2006).

Fully balanced cross-lagged path models were first tested (see Figure 2). These analyses resulted in saturated models, which can complicate the interpretation of model fit (Byrne 2010). Moreover, the saturated models revealed several non-significant covariate effects, which may constrain precise estimation in small samples by ineffectively using up degrees of freedom. Consequently, we removed the non-significant covariate paths from receptive language and gender to emotion recognition and problem behaviors in 1st and 3rd grade from model estimation. These changes resulted in good model fit for the hyperactivity and internalizing behavior models and adequate model fit (as indicated by the χ^2 , CFI, and SRMR indices) for the externalizing behavior model; model fit statistics are presented in Table 3. Figures 3–5 depict the final cross-lagged models for hyperactivity, internalizing behaviors, and externalizing behaviors, respectively.

Concurrent associations in the path models mirrored correlational analyses. Across models, emotion recognition was negatively associated with problem behaviors in 1st grade, whereas concurrent associations in 3rd grade were not significant. As expected and consistent with previous research, receptive language ability was positively associated with emotion recognition skills in 1st grade and negatively associated with problem behaviors in 1st grade, suggesting that greater receptive language ability was associated with greater emotion recognition skills and fewer problem behaviors in 1st grade. Gender was associated with hyperactivity in 1st and 3rd grade, indicating that boys were rated by teachers as displaying more hyperactivity across time as compared to girls.

With regard to cross-lagged effects, results partially supported our hypotheses. Contrary to our expectations, emotion recognition in 1st grade was not uniquely predictive of hyperactivity in 3rd grade, $\beta = -.03$, $p = .747$. However, as predicted, the inverse path was marginally significant, $\beta = -.21$, $p = .053$: greater hyperactivity in 1st grade tended to predict lower levels of emotion recognition in children in 3rd grade. As predicted, lower emotion recognition in 1st grade predicted greater levels of internalizing behaviors in 3rd grade, $\beta = -.20$, $p = .029$, but internalizing behaviors in 1st grade were not significantly predictive of emotion recognition in 3rd grade, $\beta = -.17$, $p = .112$. The model examining externalizing behaviors revealed no significant cross-lagged paths (β s = .04 and $-.05$, $ps = .718$ and $.646$ for 1st grade emotion recognition and externalizing behavior, respectively), indicating that children's emotion recognition skills and externalizing behaviors were not longitudinally interrelated between 1st and 3rd grade.⁴ Notably, emotion recognition and all three problem behaviors demonstrated moderate stability over time as indicated by the auto-correlations.

⁴This pattern held when controlling for effects of child ethnicity on 1st and 3rd grade externalizing behaviors; see Appendix.

Discussion

Our primary aim was to explore the longitudinal linkages between children's abilities to recognize emotional expressions and their hyperactivity, internalizing behaviors, and externalizing behaviors over a two-year period spanning early to middle childhood. Two unique unidirectional pathways emerged: (1) hyperactivity in 1st grade to emotion recognition in 3rd grade, and (2) emotion recognition in 1st grade to internalizing behaviors in 3rd grade. These results—based on fully cross-lagged path models that controlled for stability in emotion recognition and problem behaviors and concurrent effects between emotion recognition and problem behaviors and between early receptive language skill and emotion recognition and problem behaviors—extend previous research using cross-sectional or incomplete longitudinal designs to better inform our understanding of how and at which ages emotion recognition difficulties develop in relation to problem behaviors and vice versa in childhood.

Early emotion recognition difficulties do not appear to contribute to further development of hyperactivity, at least not in our sample of children in 1st and 3rd grade. Although Izard et al. (2001) found that emotion recognition related negatively to hyperactivity between the ages of 5 and 9, the effect was similar in magnitude to the present finding, and the researchers did not control for the concurrent association between emotion recognition and hyperactivity at age 5 nor the stability in hyperactivity over time. Moreover, an a priori multiple regression power calculation (conducted post hoc) using G*Power, with a two-tailed alpha value of .05, Cohen's $f^2 = .07$ (effect size taken from Izard et al., 2001) and three predictors, yielded a recommended sample size of 115; our study, thus, was sufficiently powered to detect this effect if it were present.

Our results suggest, instead, that early hyperactivity may attenuate the development of emotion recognition skills over time as indicated by the marginally significant path between hyperactivity in 1st grade and emotion recognition in 3rd grade. Hyperactivity, with its features of rapid attention shifts and distractability (Gresham and Elliot 1990), may reduce children's ability to attend to the facial, vocal, and bodily cues of others. Consequently, children with greater hyperactivity may fail to improve their emotion recognition accuracy with age, whereas children without hyperactivity demonstrate gains in their skills over time. Further, inattention and poor behavioral self-regulation may constrain children's interpersonal interactions in that others may avoid or minimize interactions with children who do not attend to and respond appropriately to their emotional cues (e.g., during times of emotional distress). As a result, children experiencing hyperactivity may miss important opportunities to learn about others' emotions and practice their skills in recognizing and responding to these emotional displays. An alternative interpretation of our result is that hyperactive children simply could not pay attention during the emotion recognition assessment in 3rd grade. This interpretation, however, seems unlikely given the non-significant concurrent association between hyperactivity and emotion recognition in 3rd grade.

Predictions regarding the emotion recognition-to-internalizing behaviors pathways were supported; emotion recognition difficulties in 1st grade contributed to greater levels of

internalizing behaviors in 3rd grade, but the inverse path was not significant. Our results indicate that children who are unable to accurately identify others' emotions are at a greater risk for developing internalizing behaviors over time. Because internalizing behaviors are often associated with self-focused anxiety (Eisenberg et al. 2001), emotion recognition—by definition, a skill directed towards others—may promote an outward focus, thus resulting in fewer internalizing thoughts. Accordingly, children who misinterpret others' emotional experiences may fail to create better interpersonal interactions and may then actually increase their own social anxieties because of their inaccurate assessments of the interaction, thereby contributing to increased internalizing behaviors over time. Now that this linkage over time has been demonstrated, future work should aim to delineate whether these effects occur at the attentional level—being aware of and attending to the nonverbal communication signals—or the interpretive level—being able to assess the meaning of signals which may be ambiguous, mixed, partial, or masked.

Given previous evidence of weak effects (Strand et al. 2008), it is not surprising that we found no evidence that 6-year-old children's internalizing behaviors predicted their emotion recognition skills two years later. Nevertheless, given the magnitude of the standardized regression coefficient and the proximity of the p -value to the significance threshold of .05, we recognize that assessment of this effect may have been underpowered. Indeed, an a priori multiple regression power calculation (conducted post hoc) using G*Power, with a two-tailed alpha value of .05, Cohen's $f^2 = .03$ (effect size taken from Strand et al., 2008) and two predictors, yielded a recommended sample size of 264. Thus, we cannot conclude that there is no effect of early internalizing behaviors on later emotion recognition as we did not have the sample size needed to detect a small effect. Future studies should replicate our model with the required sample size. Additionally, because internalizing behaviors could potentially motivate children's vigilance for emotion-related cues in others, or the worry associated with internalizing behavior might reduce accuracy in interpreting these cues, future work might attempt to distinguish between attentional skills (noticing the available emotional information in a facial expression) and interpretive skills (correctly identifying the emotional meaning of a facial expression) in relation to internalizing behaviors.

Finally, and consistent with the limited previous work (i.e., Izard et al. 2001; Székely et al. 2014), emotion recognition and externalizing behaviors were not significantly longitudinally associated from 1st to 3rd grade, when accounting for receptive language ability. One possibility is that our study and others were simply underpowered to detect these effects. Given our observed effect sizes, however, this possibility is unlikely. Post hoc power calculations using G*Power, with a two-tailed alpha value of .05, Cohen's $f^2 = .32$ (predicting third-grade externalizing behaviors; transformed from our model effect size) and .07 (predicting first-grade emotion recognition at Grade 1; transformed from our model effect size), three predictors, and our sample size ($N = 117$), indicated that our path model was sufficiently powered (81% and 99.9% power, respectively). Additional post hoc power calculations using G*Power, with a two-tailed alpha value of .05, Cohen's $f^2 = .13$ (first-grade emotion recognition predicting third-grade externalizing behaviors; transformed from the bivariate correlation) and .07 (first-grade externalizing behaviors predicting third-grade emotion recognition; transformed from the bivariate correlation), three predictors, and our sample size ($N = 117$), also indicated sufficient power (81% and 95%, respectively).

Given these post hoc power analyses and our replication of previous null effects, a second, stronger possibility is that emotion recognition and externalizing behaviors are not longitudinally related between the ages of 6 and 8. Instead, externalizing behaviors may matter more for emotion recognition development in early childhood when children are still acquiring basic information about what emotional expressions look and sound like and how these expressions map onto what others are feeling (or not feeling). Indeed, one study found that externalizing behaviors at 18 months predicted children's abilities to *match* different emotional expressions at 36 months, but not the ability to *label* emotional expressions (Székely et al. 2014), suggesting the possibility of a sensitive period. Alternatively, externalizing behaviors may be less influenced by emotion recognition and more influenced by emotion knowledge (Fine et al. 2003; Locke, Seifer, Miller, and Heinze 2015), defined as the situational and contextual information used to attribute emotions to people (Castro, Cheng, et al. 2016). Individuals who exhibit greater externalizing behaviors may lack an understanding of how their own behaviors affect the interaction, or may be unable to predict how and why another person will respond in an interaction. In this way, it may not be a lack of recognition, per se, that is harmful in the interaction, but instead, a lack of situational knowledge that would dictate appropriate behavioral engagement.

Interestingly, gender was not significantly associated with emotion recognition at either time point in our study. These findings are consistent with meta-analytic evidence indicating that gender effects are stronger in adolescence and adulthood and relatively weak in childhood (Hall et al., 2016). With regard to receptive language, results from the fully cross-lagged path models revealed significant associations with emotion recognition and with problem behaviors in 1st grade only (in contrast to the Strand et al. 2016 study of 5-year olds), suggesting that receptive language ability may be less influential for later emotion recognition and problem behavior development. We note that our study differs from past research by targeting older children across a longer period of time.

Limitations, Strengths, and Future Directions

In the present study, we tested the differential developmental pathways for each problem behavior separately, and this strategy is justified by the divergent cross-lagged effects found across hyperactivity, internalizing behaviors, and externalizing behaviors. Nevertheless, future research may aim to estimate all three problem behaviors in the same model or utilize person-centered approaches, such as latent profile analysis, to determine inter-individual and intra-individual differences in these linkages over time, as well as the extent to which these linkages are affected by comorbidity among problem behaviors.

Our longitudinal study improves upon previous attempts to infer developmental processes from concurrent or incomplete longitudinal associations, but it is still limited to only two time points. Because the ideal time frame for examining these processes over time is unknown, our longitudinal design spanning two years may have missed a sensitive period during which these skills mutually develop. Elementary-school-age children continuously encounter new or alternative environments that require increasingly complex social and emotional skills, including the ability to identify and interpret multiple, mixed, and fragmented expressions (Halberstadt et al. 2013). These skills likely become more accurate

and efficient over time as children practice with new people in new situations. The longitudinal impact of emotion recognition may be weak, or may ebb and flow alongside age-related changes in developmental competencies and environmental demands. Future research that includes more time points closer together could provide a stronger test of the mutual development of emotion recognition and problem behaviors and the ages at which each behavior (hyperactivity, internalizing, and externalizing) is most likely to affect and be affected by emotion recognition skills.

Additionally, our sample was limited in size and may have been underpowered to detect very small cross-lagged effects such as that from early internalizing behaviors to later emotion recognition. Because no studies have utilized a fully cross-lagged model to test these associations, power calculations that rely on observed (published) effects sizes may not accurately reflect true effect sizes; moreover, such effects may be less informative in the calculation of power for studies that utilize a more stringent design that accounts for concurrent effects and covariates (such as ours). Indeed, our observed effect sizes may be used in future power calculations, and we hope that researchers will use this information to replicate our models with larger sample sizes.

Importantly, our findings highlight the fact that cross-sectional effects vary drastically from longitudinal effects. That is, although we found significant concurrent associations between problem behaviors in 1st grade and non-significant associations in 3rd grade, we found one significant and one marginal longitudinal association. Thus, not only might cross-sectional findings vary at different ages, but they may—as our findings strongly suggest—also result from different underlying mechanisms.

Finally, our results also emphasize the need for future research to differentiate problem behaviors. The fact that hyperactivity marginally impeded emotion recognition development, but not vice versa, and that poor emotion recognition significantly promoted the development of internalizing behaviors, and not vice versa, indicate differing developmental patterns for hyperactivity and internalizing behaviors. More research is needed that employs multimethod, fully-balanced, longitudinal designs to better capture the sensitive periods during which emotion recognition skills and problem behaviors mutually develop. Examination of these associations in relation to other aspects of emotion understanding (e.g., emotion knowledge) beyond emotion recognition is also warranted.

It is important to note that our findings speak most directly to normative socioemotional trajectories, but also provide fundamental insight into the potential emotional underpinnings of more severe problem behaviors, and particularly internalizing behaviors and hyperactivity. To determine whether our findings would be replicated in an at-risk sample, clinical researchers who focus on the etiology of problem behaviors should give full consideration to the conceivable role of emotional processes (e.g., emotion recognition) in their theoretical frameworks and empirical inquiries. Our study with typically developing children reflected low levels of problem behaviors, as the average teacher-reported behaviors were well below the mid-point on the scales (see Table 1). These findings are consistent with reports of low base rates of problem behaviors in normative samples (Gresham, Elliott, and Kettler, 2010). Without problem behaviors that might compete with, interfere with, or block

the acquisition of social skills (Gresham and Elliott, 1990, 2008), children are better able to profit from opportunities to learn socially adaptive behaviors, such as emotion recognition, as well as other prosocial behaviors and peer-related social skills (Eddy, Reid, and Curry, 2002; Gresham, Van, and Cook, 2006). As such, children with low levels of problem behaviors are likely to be more socially skilled and thus more able to interact successfully with both their peers, who would still be learning and practicing their own emotion recognition skills, and adults, who should be relatively skilled in emotion recognition and thus able to further scaffold children's learning. It may be that children with excellent emotion recognition skills and exemplary social behaviors beget a more privileged amount of learning and honing of skills than less emotionally and socially adept children.

In sum, the results from cross-lagged analyses suggest the impact of hyperactivity in attenuating the development of skill in recognizing emotion from 1st to 3rd grade. Additionally, analyses indicate the impact of emotion recognition difficulties over time in increasing internalizing behavior above and beyond existing levels in 1st to 3rd grade. Thus, in addition to the issues associated with sitting still and being easily distracted, etc., individuals with hyperactive patterns of behavior may also accumulate difficulties interpreting other's emotional and social cues even when they are paying attention. In addition, weaker skill in emotion recognition may, over time, create interpersonal situations that exacerbate elementary school-age children's anxiety and withdrawal from playmates. Both types of challenges can be addressed through the various evidence-based emotion recognition and socioemotional learning interventions available in schools for this age group (e.g., Greenberg and Kusche 2006; Hagelskamp, Brackett, Rivers, and Salovey 2013; Izard 2004). Our findings further inform such programs by highlighting the mutual development of emotion recognition skill and behavioral problems over time.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix

Table 4

Results Comparing European Children and African American/Biracial on their Emotion Recognition and Problem Behavior in 1st and 3rd Grade

Variable	1 st Grade			3 rd Grade		
	<i>t</i>	<i>df</i>	<i>p</i>	<i>t</i>	<i>df</i>	<i>p</i>
Emotion Recognition	−0.79	112	.432	−0.31	115	.412
Hyperactivity	−0.90	74	.372	−1.30	89	.197
Internalizing Behaviors	−1.37	74	.174	−1.10 ^a	86.13	.273
Externalizing Behaviors	−1.32 ^a	−2.03	.046	−2.36	89	.020

Note:

^aLevene's test significant; thus, alternative statistic reported for equal variances not assumed.

Negative *t* statistic indicates that African American/Biracial children scored higher than European American children.

Figure 6.

Cross-lagged path model of children's emotion recognition and externalizing behaviors in 1st grade predicting children's emotion recognition and externalizing behaviors in 3rd grade, controlling for receptive language skill in 1st grade and child ethnicity. Dashed lines indicate nonsignificant paths. Solid lines indicate significant paths, and include the standardized regression coefficient. Patterns mirror those of the model omitting child ethnicity as a predictor.

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

Figure 1.

Visual depiction of the Increasingly Clear Emotions task. Emotional expressions unfolded in rounds, with each round displaying expressions that were increasingly clearer than the previous round. For the present study, children were presented with Rounds 3 through 6, as indicated by the outlined box.

Figure 2.

Initial fully cross-lagged path model of children's emotion recognition and problem behaviors in 1st grade predicting children's emotion recognition and problem behaviors in 3rd grade, controlling for receptive language skill and child gender. Additional concurrent paths were modelled between children's emotion recognition and problem behaviors in 1st and 3rd grade. Three separate models were tested for hyperactivity, internalizing behaviors, and externalizing behaviors, respectively.

Figure 3.

Cross-lagged path model of children's emotion recognition and hyperactivity in 1st grade predicting children's emotion recognition and hyperactivity in 3rd grade, controlling for receptive language skill in 1st grade and child gender. Dashed lines indicate non-significant paths. Solid lines indicate significant paths, and include the standardized regression coefficient. Trends noted where appropriate. † $p < .10$.

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

Figure 4.

Cross-lagged path model of children's emotion recognition and internalizing behaviors in 1st grade predicting children's emotion recognition and internalizing behaviors in 3rd grade, controlling for receptive language skill in 1st grade. Dashed lines indicate non-significant paths. Solid lines indicate significant paths, and include the standardized regression coefficient. Trends noted where appropriate. $\dagger p < .10$.

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

Figure 5.

Cross-lagged path model of children's emotion recognition and externalizing behaviors in 1st grade predicting children's emotion recognition and externalizing behaviors in 3rd grade, controlling for receptive language skill in 1st grade. Dashed lines indicate non-significant paths. Solid lines indicate significant paths, and include the standardized regression coefficient. Trends noted where appropriate. * $p < .05$.

** $p < .01$. *** $p < .001$.

Table 1

Descriptive Statistics for Emotion Recognition and Problem Behavior Measures

Variable	1 st Grade				3 rd Grade			
	<i>N</i>	Range	<i>M</i>	<i>SD</i>	<i>N</i>	Range	<i>M</i>	<i>SD</i>
Emotion Recognition <i>I</i>	117	0.00–1.00	0.80	0.19	114	0.33–0.69	0.57	0.07
Social Skills Rating System								
Hyperactivity	76	0.00–2.00	0.49	0.57	91	0.00–1.83	0.55	0.50
Internalizing Behaviors	74	0.00–1.83	0.27	0.38	91	0.00–1.67	0.44	0.46
Externalizing Behaviors	76	0.00–2.00	0.26	0.44	91	0.00–2.00	0.38	0.53

I ACES was administered in 1st grade; ICE was administered in 3rd grade.

Table 2

Correlations between Children's Gender, PPVT, Emotion Recognition, and Problem Behaviors in 1st and 3rd Grade

Measure	Covariates		Emotion Recognition			1 st Grade Problem Behaviors ^b			3 rd Grade Problem Behaviors ^b		
	Child Gender ^a	1 st Grade Language	1 st Grade	3 rd Grade	Hyper	Intern	Extern	Hyper	Intern	Extern	
Covariates											
1 st Grade Language	.03										
Emotion Recognition											
1 st Grade	-.04	.25**									
3 rd Grade	.09	.12	.25**								
1 st Grade Problem Behaviors ^b											
Hyperactivity	-.17	-.25*	-.21 [†]	-.24*							
Internalizing	-.17	-.33**	-.23*	-.18	.37***						
Externalizing	-.17	-.32**	-.27*	-.07	.63**	.42***					
3 rd Grade Problem Behaviors ^b											
Hyperactivity	-.32**	-.25*	-.15	-.05	.53***	.17	.52***				
Internalizing	-.22*	-.31**	-.30**	-.13	.21 [†]	.45***	.43***	.34***			
Externalizing	-.30**	-.35**	-.13	-.19 [†]	.50***	.11	.42***	.70***	.31**	—	

Note:

^a Gender coded as 0 = boys, 1 = girls;^b square-root transformed.

Hyper = Hyperactivity; Intern = Internalizing Behaviors; Extern = Externalizing Behaviors.

[†] $p < .10$.* $p < .05$.** $p < .01$.

Table 3

Fit Statistics for Tested Cross-lagged Models

Model	Fit indices						
	<i>df</i>	χ^2	CFI	TLI	RMSEA	90% CI	SRMR
Hyperactivity	5	3.42	1.00	1.09	.00	.00–.11	.03
Internalizing Behaviors	2	2.03	1.00	1.00	.01	.00–.18	.03
Externalizing Behaviors	2	3.77	.95	.77	.09	.00–.22	.04