The Heterogeneity of ADHD Symptoms and Conduct Problems:

Cognitive inhibition, Emotion Regulation, Emotionality and Disorganized Attachment

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Abstract

This study examined the contributions of several important domains of functioning to ADHD symptoms and conduct problems. Specifically, we investigated if cognitive inhibition, emotion regulation, emotionality and disorganized attachment made independent and specific contributions to these externalizing behavior problems from a multiple pathways perspective. The study included laboratory measures of cognitive inhibition and disorganized attachment in 184 typically developing children (*M* age = 6 years, 10 months, *SD* = 1.7). Parental ratings provided measures of emotion regulation, emotionality, and externalizing behavior problems. Results revealed that cognitive inhibition, regulation of positive emotion, and positive emotionality were independently and specifically related to ADHD symptoms. Disorganized attachment and negative emotionality formed independent and specific relations to conduct problems. Our findings support the multiple pathways perspective on ADHD, with poor regulation of positive emotion and high positive emotionality making distinct contributions to ADHD symptoms. More specifically, our results support the proposal of a temperamentally based pathway to ADHD symptoms. The findings also indicate that disorganized attachment and negative emotionality constitute pathways specific to conduct problems rather than to ADHD symptoms.

Keywords: ADHD, conduct problems, cognitive inhibition, emotion regulation, emotionality, disorganized attachment.

The Heterogeneity of ADHD Symptoms and Conduct Problems: Cognitive Inhibition, Emotion Regulation, Emotionality and Disorganized Attachment

Externalizing behavior problems, such as Attention-Deficit/Hyperactivity Disorder (ADHD) and conduct problems, are increasingly suggested to be etiologically heterogeneous (Dodge & Pettit, 2003; Nigg, Willcutt, Doyle, & Sonuga-Barke, 2005; Sonuga-Barke, 2005). Indeed, the development of conduct problems has long been related to impairments in a multitude of factors, such as emotion regulation, emotionality, cognitive inhibition, and attachment (Dodge & Pettit, 2003). Similarly, current theoretical models of ADHD suggest multiple pathways to the disorder (Nigg, Goldsmith, & Sachek, 2004; Sonuga-Barke, 2005), and recently deficits in emotion regulation and extreme emotionality (Martel, 2009), as well as insecure attachment have been emphasized (Thorell, Rydell, & Bohlin, 2012; for a discussion see Nigg, 2006). There is a shortage of studies simultaneously investigating factors from multiple domains of functioning in relation to both ADHD symptoms and conduct problems. Moreover, few studies have accounted for the substantial overlap between ADHD symptoms and conduct problems. Addressing these limitations would clarify impairment specificity for respective type of externalizing behavior problems, which in turn would help to improve intervention targets (Moffitt et al., 2011; Sonuga-Bark, 2005).

Externalizing behavior problems have been shown to be best understood from a dimensional perspective, which means that clinical features of disorders should be taken as representing the extreme end of normal traits (Marcus & Barry, 2011). For example, research in ADHD has found a dimensional latent structure rather than a taxonomic one, using a variety of raters and methods in clinically referred samples (Frazier, Youngstrom, & Naugle, 2007), as well as samples from the general population (Haslam et al., 2006; Marcus & Barry, 2011). This means that quantitative rather than qualitative deviations in behaviors and psychological functions are to be expected in children high in ADHD-symptoms compared to

children low in these symptoms. Therefore, studies with typically developing children should increase our understanding of functioning in clinical groups (Nigg, 2001; Thorell & Wåhlstedt, 2006).

Cognitive Inhibition in Relation to Conduct Problems and ADHD symptoms

Deficits in the ability to inhibit an inappropriate response in favor of a more appropriate alternative, or cognitive inhibition (Nigg, 2003; Sonuga-Barke, 2005), have long been established as an important neuropsychological contribution to ADHD symptoms (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Deficits in cognitive inhibition have also been linked to conduct problems (Hobson, Scott & Rubia, 2011; Hughes & Ensor, 2011; Sergeant, Geurtz & Oosterlaan, 2002), albeit not to the same extent as to ADHD symptoms. The majority of research controlling for the overlap between ADHD symptoms and conduct problems indicates that cognitive inhibition is primarily related to ADHD symptoms (Brocki, Nyberg, Thorell, & Bohlin, 2007; Oosterlaan, Scheres, & Sergeant, 2005; Thorell & Wåhlstedt, 2006). There are however conflicting findings (see Hobson et al., 2011; Osterlaan, Logan & Sergeant, 1998) and more research is warranted.

Emotion Regulation and Emotionality in Relation to ADHD Symptoms and Conduct Problems

Emotion regulation is the process for monitoring, evaluating, and modifying emotional reactions, especially intensive and temporal features, to achieve one´s goals (Gross & Thompson, 2007). Deficits in emotion regulation have long been associated with both ADHD symptoms and conduct problems, but it is unclear if deficits in emotion regulation are independent of deficits in other domains of functioning related to externalizing behavior problems (Martel, 2009; Mullin & Hinshaw, 2007). Links between emotion regulation and cognitive inhibition have been suggested both theoretically (Barkley, 1997) and empirically (Carlson & Wang, 2007; Maedgen & Carlson, 2000; Walcott & Landau, 2004). However,

Sjöwall, Roth, Lindqvist and Thorell (2013) found that emotion regulation contributed to ADHD symptoms independently of executive functions.

Results on the specificity of emotion dysregulation in relation to symptoms of ADHD and conduct problems have been conflicting. Some studies have reported a specific link between emotion regulation deficits and ADHD symptoms when controlling for conduct problems (Bunford, Evans, Becker, & Langberg, 2014; Seymour, Chronis-Tuscano, Iwamoto, Kurdziel, & MchPherson, 2014; Sjöwall et al., 2013), whereas others report deficits in emotion regulation only for ADHD-children with comorbid conduct problems (Maedgen & Carlson, 2000; Melnick & Hinshaw, 2000). These inconsistencies may partly be explained by methodological differences in the emotion regulation measures used. Several studies have used global measures, which precludes differentiation of the relative importance of regulation of positive and negative emotion. Indeed, dysregulation of negative emotion has long been associated with conduct problems (Eisenberg et al., 2001; Frick & Morris, 2004; Martel, 2009; Nigg et al., 2004) whereas dysregulation of intense positive emotion, exuberance, has recently been suggested as a specific risk factor for ADHD (Martel, 2009; Musser, Galloway-Long, Frick, & Nigg, 2013; Nigg et al., 2004). Supporting this hypothesis, Sjöwall et al. (2013) found a specific association between dysregulation of exuberance and ADHD symptoms.

Emotionality is often extreme among children with externalizing behavior problems and may interfere with emotion regulation (Martel, 2009, Martel & Nigg, 2006; Mullin & Hinshaw, 2007; Nigg, et al., 2004). Current multiple pathway models for ADHD propose complementary roles for emotion regulation and emotionality, but the contribution of each remains to be empirically tested (Martel, 2009; Nigg et al., 2004). Importantly, findings support treating emotion regulation and emotionality as related but distinct constructs (Cole, Martin, & Dennis, 2004; Martel, 2009), as evidenced by differential relations to behavioral

outcomes (Eisenberg, Spinrad, & Eggum, 2010). More research is needed that takes into account this overlap in order to provide a clearer picture of the respective roles of emotion regulation and emotionality in relation to externalizing disorders.

Disorganized Attachment in Relation to ADHD Symptoms and Conduct Problems

Disorganized attachment has also been linked to externalizing problems (Bohlin, Eninger, Brocki, & Thorell, 2012; Carlson, 1998; Lyons-Ruth, Easterbrooks, & Cibelli, 1997). In contrast to secure and organized/insecure attachment, disorganized attachment (henceforth referred to as disorganization) is marked by an inability to sustain an organized pattern of behavior during stressful situations (Main, Hesse, & Kaplan, 2005; Main & Solomon, 1990; Sroufe, Egeland, Carlson, & Collins, 2009). This is suggested to be a result of children experiencing a caregiver as frightening or frightened (Hesse & Main, 2000; Schuengel, Bakermans-Kranenburg, & van IJzendoorn, 1999). Disorganization is thought to cause externalizing behavior problems through negative expectancies on the self and others, as well as through negative effects on other domains of functioning important for goal-directed behavior, such as emotional functioning (Cassidy, 1994; DeOliveira, Bailey, Moran, & Pederson, 2004) and cognitive control (Bernier, Carlson, Deschênes, & Matte-Gagné, 2012).

Disorganization has consistently been associated with conduct problems (Fearon, Bakermans-Kranenburg, Van IJzendoorn, Lapsley, & Roisman; 2010), and more recently with ADHD symptoms (Bohlin et al., 2012; Thorell et al., 2012). However, it remains an open question as to whether disorganization is independently linked to externalizing behavior problems beyond dysfunction in other domains. The few studies on disorganization in relation to ADHD symptoms that have controlled for cognitive control report an independent link between disorganization and ADHD symptoms (Bohlin et al., 2012; Thorell et al., 2012; Scholtens, Rydell, Bohlin, & Thorell, 2014). These studies, however, each measured

attachment representations using the same story-stem method (George & Solomon, 2000), which requires children to produce coherent narratives. This attachment measure is potentially compromised by difficulties in narrative coherence that children high in ADHD symptoms often display. Consequently, there is a need for other instruments in measuring disorganization in attachment research (Scholtens et al., 2014).

Regarding specificity, Nigg (2006) suggested that co-occurrence of disturbances, such as conduct problems, may account for the link between disorganization and ADHD symptoms. Indeed, existing findings are limited and inconsistent, with some studies showing a specific association between disorganized attachment and ADHD symptoms (Thorell et al., 2012), while others do not report such a pattern (Bohlin et al., 2012).

Aims of the study

The present study was based on the multiple pathways perspective and examined cognitive inhibition, emotion regulation, emotionality, and disorganization in relation to ADHD symptoms and conduct problems. Our first aim was to explore whether these domains of functioning make independent contributions to ADHD symptoms and conduct problems respectively. Our second aim was to examine if these domains relate specifically to ADHD symptoms or conduct problems when controlling for symptom overlap. We kept regulation of positive and negative emotion separate, as well as their respective emotionality, to investigate their relative importance for ADHD symptoms and conduct problems. We adopted a dimensional perspective that allowed for the control of symptom overlap including subclinical levels, as opposed to a categorical approach in which subclinical levels of symptoms are lost. In line with previous findings linking cognitive inhibition to ADHD symptoms, we predicted that cognitive inhibition would contribute to ADHD symptoms independently of emotion regulation, emotionality, and disorganized attachment, and would be specific to ADHD. We made no predictions for contributions of emotion regulation, emotionality, and disorganized

attachment due to inconsistencies in previous findings on their relation to conduct problems and ADHD symptoms.

Method

Participants and Procedure

The sample consisted of 184 children (49% boys) aged 6-7 years (*M* = 6 years, 10 months *SD* = 1.7) living in the county of a university town in Sweden. The majority of children were born in Sweden (97%) and living with both parents (91%). Parental educational status was high, with 74% of the children having at least one parent with a university education. The children in this study are a subsample of children participating in a larger longitudinal study examining factors associated with susceptibility for, as well as resilience against, behavior problems. This study presents data from all participants who agreed to participate in the laboratory part of the study, which included a visit to the department lasting approximately 2 hours with a short break halfway through. Children were tested individually in a quiet room and performed a battery of EF tasks and an attachment representation task (fixed order), while the accompanying parent(s) (84% mothers) filled in questionnaires in an adjacent room. The children received a toy worth approximately $10 and the parent(s) received a gift voucher worth approximately $12. The study was evaluated to be in accordance with the ethical standards of the Swedish Research Council and as declared in the declaration of Helsinki. Informed consent was obtained from all the participants included in the study and their accompanying parent(s).

Measures

Cognitive inhibition. Interference control was measured using a Stroop-like task derived from the Day-Night Stroop task (Gerstadt, Hong, and Diamond, 1994). The administrator presented children with pictures on a computer screen, one at a time, from three picture pairs (boy/girl, night/day, up/down). Conflict was created by instructing children to

say the opposite of what they saw on the screen. The task included a total of 48 trials divided into two conditions of 24 trials each. Inter Stimulus Interval was 2500 ms in both conditions with presentation time of the pictures 1200 and 800 ms respectively (See Berlin & Bohlin, 2002 for further details). This task has been shown to have adequate test-retest reliability (Thorell & Wåhlstedt, 2006) and to load on the same factor as other measures of cognitive inhibition (Berlin & Bohlin, 2002; Bohlin et al., 2012). Performance on this task also predicts ADHD symptoms (Thorell & Wåhlstedt, 2006) and discriminates between children with ADHD and control children (Berlin, Bohlin, Nyberg, & Janols, 2004). We used the total number of corrected and uncorrected mistakes as no response was likely a result of difficulties with the task unrelated to inhibitory control. To account for silent responses, a coefficient of cognitive inhibitory control was calculated as the number of mistakes divided by the total number of pictures responded to. Scores were reversed, so that high numbers indicated better inhibitory control.

Inhibition of prepotent responses was measured using a computerized go/no go task (Berlin & Bohlin, 2002). The administrator presented the stimuli (blue square, blue triangle, red triangle, and red square) to children one at a time on a computer screen and instructed them to press a key (“go”) when some of the stimuli (blue) appeared on the screen, and to make no response (“no-go”) when other stimuli (red) appeared. The rules were changed in the second part of the task to “go” stimuli being triangles irrespective of color. Prepotency was provided by the majority of the trials being “go-targets”. Altogether the task included 80 presentations with a go-rate of 70%. Inter stimulus interval was 2500 ms in both conditions, with presentation time of 1200 and 800 ms respectively. Performance on this task has been related to performance on other tasks for cognitive inhibition (e.g., Bohlin et al., 2012; Berlin & Bohlin, 2002) and to ADHD symptoms in several studies (e.g., Berlin & Bohlin, 2002; Brocki & Bohlin, 2006; Brocki et al., 2007). We used the total number of correct responses

minus commission errors (i.e. pressing the key when a "no-go" target was presented) as a measure of inhibitory control of prepotent responses, with higher scores indicating better inhibitory control. A composite of cognitive inhibition was calculated using the mean standardized scores for the two tasks measuring cognitive inhibition (r = .33, p <.001).

Emotion regulation. Accompanying parent(s) rated their child´s emotion regulation and emotionality using the Emotion Questionnaire short form (Rydell et al., 2003). Emotion regulation was measured with two questions per emotion, reflecting the child's capacity to regulate anger, fear, sadness, and happiness/exuberance with and without the assistance of others. Emotionality was similarly measured with two questions per emotion to assess the frequency and intensity of emotionality for each of the four emotions. Each question was scored on a scale ranging from 1 *(doesn't apply at all*) to 5 (*applies very well*). We calculated mean scores separately for emotion regulation and emotionality of both happiness/exuberance and negative emotionality. Ratings of anger, sadness, and fear formed scores for emotion regulation and emotionality of negative emotion. Higher values indicated higher emotion regulation abilities and higher frequency/intensity of emotionality. This questionnaire has been shown to have high test-retest reliability and construct validity (Rydell et al., 2003). Previous studies have also used this questionnaire to examine emotion regulation and emotionality in relation to conduct problems and ADHD symptoms. (e.g., Berlin et al., 2004; Rydell et al., 2003/2007; Sjöwall et al., 2013). Regulation of negative emotions (anger, sadness and fear) were highly correlated (rs = .62 - .71, p < .001), and Cronbachs alpha was .83. Emotionality for the negative emotions were also highly correlated (rs = .52 - .70, p < .001), and Cronbachs alpha was .84. The two items measuring regulation of positive emotion/exuberance were also highly correlated (r = .50, p < .001), as were the two items measuring emotionality (r = .43, p < .001).

Attachment representations. Child attachment representations were measured with the Separation Anxiety test (SAT; Kaplan 1987). The researcher presented children with six black and white drawings (fixed order), from the Swedish translation of the interview system (Broberg, Wiberg, & Karlsson, 2000). The pictures depicted separation situations between an androgynously illustrated child and two parents with neutral affective expressions. For every picture the administrator first gave a short vignette (e.g. "in this picture mom and dad are going away for the weekend, and the child is to stay with his/her relatives"). The illustrated child was always described as the same sex as the interviewed child. The researcher asked the children (1) how the child in the picture was feeling, (2) why the illustrated child was feeling that way, and (3) what the illustrated child would do. As advised by Kaplan (1987), we used standardized probes (e.g. "take a guess") if children did not respond at all or if they did not know, and 15 follow-up probes (e.g. "is the boy/girl" angry) on four of the six pictures. The interviews were recorded with a non-obtrusive .mp3 recorder, transcribed and coded according to Kaplan´s (1987) coding manual.

Responses were coded into the four attachment categories. Responses were coded as *"secure-resourceful"* if participants described vulnerable feelings for the illustrated child, and described active and constructive solutions for how the illustrated child dealt with the situations. Responses were coded as *"insecure/avoidant-inactive"* if the participants failed to describe constructive solutions (e.g. "I don´t know"/"do nothing"). Responses were coded as *insecure/ambivalent-aggressive* if participants described contradictory solutions, such as seeking contact with parents in one situation and being aggressive in others. Responses were coded as *insecure/disorganized-fearful* if the illustrated child seemed inexplicably afraid and unable to do anything about it, or if the participant reacted to the interview situation with disorganized out of control behavior (e.g. hurting him-/herself, being mean to the administrator). Indices of disorganization also included markedly prolonged silences, refusal

to say anything, refusal to finish the task, prolonged or marked whispering, linguistic disorganization (e.g. “yes-no-yes-no-yes-no”), or catastrophic fantasies in which the parents or child died or got seriously injured. The coding for attachment was thus based on the participants’ verbal answers as well as on their behaviors during the task.

Validity has been demonstrated in studies relating the SAT (as adapted by Kaplan, 1987) to previous strange situation classifications in several samples, to concurrent attachment classifications in the 6th-year-reunion procedure, and prospectively to adult state of mind regarding attachment (Jacobsen & Hofmann, 1997; Main, Hesse, & Kaplan, 2005; Main, Kaplan, & Cassidy, 1985; Grossmann et al., 2002). The first author coded the transcripts, trained to full reliability by the 4th author (>80% correct classifications across all four categories and 30 transcripts), with permission from Dr. Kaplan. We used the categorical measure of disorganization in comparison to the three organized patterns grouped together (dichotomous variable; disorganized=1, organized=0). The categorical measure of security, in comparison to the three insecure patterns grouped together (dicotomous variable; Secure=1; insecure=0), was also used as a control variable. Interrateragreement on classification over 20 cases was Cohen’s kappa k = .70 for secure/insecure, and k = .83 for DA/non-DA.

Ratings of externalizing behavior problems. Accompanying parent(s) rated ADHD symptoms using the ADHD rating scale IV (DuPaul, Thomas, & Anastopolous, 1998). The scale contains the 18 DSM-IV symptom criteria for ADHD (American Psychiatric Association, 2000), including nine questions asking about inattention, six about hyperactivity, and three about impulsivity. Each question was rated on a 4-point scale ranging from 0 (*“never/rarely”*) to 3 (*“very often”*). This scale is well validated and widely used in ADHD research (DuPaul et al., 1998). We used the mean score of all 18 questions as a measure of ADHD symptoms with higher scores indicating a higher level of ADHD symptoms. Cronbach´s alpha for the measure was .91.

The accompanying parent(s) rated their child´s conduct problems using the conduct problems subscale (5 questions) of the Swedish version of the Strengths and Difficulties Questionnaire (SDQ-Swe; Malmberg, Rydell, & Smedje, 2003). Each item was rated on a three point scale (0=*"not true"*, 1=*"somewhat true"*, 2=*"certainly true"*). We used the mean score, with higher sores indicating higher levels of conduct problems. The SDQ has been shown to discriminate between children from clinical and nonclinical groups (Malmberg et al., 2003). In the present study Cronbach´s alpha was .69.

Statistical Analyses

Data were screened for extreme values (>3 *SD*) and 11 such values were identified: three for the cognitive inhibiton tasks, one for regulation of negative emotion, five for ADHD symptoms and two for conduct problems. These values were replaced with the next most extreme value within 3 *SD* according to the winsorizing method (Tabachnick & Fidel, 2001). Analysis of univariate normality showed all variables fell within the acceptable range (skewness -.25 to 2.07, kurtosis .12 to 2.30; Kline, 2011). The regression analyses did not control for child age, sex, or parental educational status, as these variables did not affect the correlations between the domains of functioning and externalizing behavior problems.

The relations between the domains of functioning and behavior problems were first analyzed using correlations, with nominal predictors (non-disorganized/disorganized and secure/insecure) scored 0 and 1. Next, we examined if the domains of functioning made independent contributions to ADHD symptoms and conduct problems. We used ADHD symptoms and conduct problems as outcome variables in separate regression analyses. The domains of functioning that were correlated with the outcome variables were entered as predictors. We examined the specificity of contributions to ADHD symptoms and conduct problems by controlling for conduct problems in the model with ADHD symptoms as outcome, and vice versa.

Results

Table 1 shows descriptive data for continuous measures for the domains of functioning and externalizing behavior problems. Eighty-seven children (47.3%) were coded as "secure-resourceful", 47 (25.5%) as "insecure/avoidant-inactive", 23 (12.5%) as "insecure/ambivalent-aggressive", and 26 (14.1%) as "insecure/disorganized-fearful" (One child ended participation before the attachment representation task). The prevalence of disorganized attachment corresponds well to meta-analytic findings of disorganized attachment in low risk groups (van IJzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). Using DSM-IV criteria for ADHD, 11 children (6.0%) met criteria for ADHD as indicated by the presence of six or more symptoms of either inattention or hyperactivity/impulsivity (American Psychiatric Association, 2000), corresponding well to prevalence of ADHD in children from the general population (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007).

Bivariate correlations between the study variables and ADHD symptoms and conduct problems are shown in Table 2. Poor cognitive inhibition was associated with higher levels of ADHD symptoms, but was only marginally related to conduct problems. Poor regulation of positive and negative emotion, high emotionality of positive and negative emotionality, and disorganized attachment, were all associated with higher levels of ADHD symptoms as well as conduct problems. Attachment security/insecurity was unrelated to ADHD symptoms and conduct problems and was therefore dropped from further analysis.

(TABLES 1 AND 2 ABOUT HERE)

Contributions of Cognitive Inhibition, Emotion Regulation, Emotionality and Disorganized attachment to ADHD Symptoms and Conduct problems

Cognitive inhibition, regulation of positive emotion, and both positive and negative emotionality independently predicted ADHD symptoms scores, F (6, 175) = 23.48, $p < .001$,

Adjusted R^2 = .43, whereas the contributions from disorganization and regulation of negative emotion were non-significant (Table 3). When controlling for conduct problems the contributions of cognitive inhibition, regulation of positive emotion, and positive emotionality remained significant, whereas the contribution of negative emotionality was no longer significant (Table 3). To be more specific, higher ADHD scores were predicted by poorer cognitive inhibition, by poorer regulation of positive emotion, and by higher positive emotionality. Cognitive inhibition explained 2.8% of the unique variance in ADHD symptoms scores (SR^2), regulation of positive emotion 6.8%, and positive emotionality 3.9%.

Regulation of positive emotion, negative emotionality, and disorganized attachment, independently predicted conduct problems, F (5, 176) = 28.73, p <.001, Adjusted R^2 = .43, whereas the contributions of positive emotionality and regulation of negative emotionality were non-significant (Table 3). When controlling for ADHD symptoms, results showed that the contributions from disorganized attachment and negative emotionality remained significant, whereas the contribution from regulation of positive emotion did not (Table 3). In other words, higher conduct problems scores were predicted by disorganized attachment and higher levels of negative emotionality, with disorganized attachment explaining 1.1% of the unique variance in conduct problems scores (SR^2) and negative emotionality 12.4%.

(TABLE 3 ABOUT HERE)

Discussion

The present study was based on the multiple pathways perspective to externalizing behavior problems and investigated the contributions of several important domains of functioning to ADHD symptoms and conduct problems. Cognitive inhibition, regulation of positive emotion, and positive emotionality made independent and specific contributions to ADHD symptoms, supporting theoretical models of multiple pathways to ADHD symptoms. Further, disorganization and negative emotionality contributed independently and specifically

to conduct problems, indicating that previously reported links between these factors and ADHD symptoms may depend on comorbid conduct problems.

Cognitive Inhibition in Relation to ADHD Symptoms and Conduct problems

The finding that cognitive inhibition contributed specifically to ADHD symptoms is in line with a substantial amount of research based on clinical (Sergeant et al., 2002; Tillman, Brocki, Sørensen, & Lundervold, 2015), at risk (Brocki et al., 2007) and non-clinical samples (Brocki & Bohlin, 2006). More importantly, our results expand previous findings by showing that cognitive inhibition relates to ADHD symptoms independently of emotion regulation and disorganization. The absence of a relation between cognitive inhibition and conduct problems is largely in line with previous studies on low risk samples (Brocki & Bohlin, 2006). Cognitive inhibition has primarily been related to conduct problems in at-risk or clinical groups, and has generally not been shown to relate to conduct problems independently of ADHD symptoms (Brocki et al., 2007; Oosterlaan et al., 2005; Thorell & Wåhlstedt, 2006). The present findings are further supported by fMRI studies showing that pure ADHD and ODD/CD groups display differential neural activation in areas closely associated with executive functioning. Symptoms of ADHD seem to be primarily associated with decreased activity in prefrontal structures, whereas ODD/CD is primarily associated with decreased activation in limbic structures (Rubia et al., 2009a, 2009b).

Emotion Regulation and Emotionality in Relation to ADHD Symptoms and Conduct Problems

Our findings suggest distinct links to ADHD symptoms and conduct problems for regulation of positive vs. negative emotion and their respective emotionality. The specific relation between ADHD symptoms and regulation of positive emotion and positive emotionality adds evidence to the recent theoretical propositions and empirical reports of dysregulation of positive emotion in ADHD symptoms (Martel, 2009; Nigg et al., 2004;

Sjöwall et al., 2013). More specifically, our findings support the theory by Nigg and colleagues (2004) of a temperamentally based pathway to ADHD symptoms from high approach tendencies and difficulties regulating these tendencies, proposed to be independent of cognitive control. The results are also consistent with recent findings showing both elevated levels of sympathetic activation (emotionality) and parasympathetic activation (regulation) in children with ADHD, particularly for regulation of positive emotionality (Musser et al., 2013). High exuberance and difficulties in regulating exuberance may thus represent early markers for ADHD symptoms.

In line with previous findings, negative emotionality was specifically related to conduct problems and not to ADHD symptoms (Melnick & Hinshaw, 2000; Mullin & Hinshaw, 2007; see also Maedgen and Carlson, 2000). However, only negative emotionality, and not regulation of negative emotion, showed a specific link to conduct problems. Intense emotionality has been argued to interfere with emotion regulation (e.g. Nigg et al., 2004; Rydell et al 2003), which possibly explains why regulation of negative emotion did not explain additional variance in conduct problems once the influence of negative emotionality was accounted for. Our findings therefore highlight the importance of taking emotionality into account when investigating emotion regulation, and support the view that emotion regulation and emotionality play complementary yet interdependent roles in relation to externalizing behavior problems (Martel, 2009; Nigg et al., 2004).

Disorganized Attachment Representations in Relation to ADHD Symptoms and Conduct Problems

The current study replicated previous findings showing that disorganization is a risk factor for externalizing behavior problems (Bohlin et al., 2012; Fearon et al., 2010). Our findings further suggest that disorganization is primarily associated with conduct problems, supporting the notion that relations between disorganization and ADHD symptoms may

depend on comorbid conduct problems, as previously hypothesized by Nigg (2006). It has been argued that the effect of attachment quality on externalizing behavior problems is mediated by other domains of functioning, such as emotion dysregulation (Cassidy, 1994; Fearon et al., 2010). This was not the case in our study, however, as indicated by the independent contribution of disorganization to conduct problems. This finding requires replication, as the effect size was small. Future research should also investigate other possible mechanisms linking disorganization to conduct problems, such as social cognitive biases associated with frightened/frightening caregiver behaviors and callous unemotional traits (Bohlin et al, 2012).

In contrast to recent findings, disorganization did not make an independent contribution to ADHD symptoms (Bohlin et al., 2012; Thorell et al., 2012). A possible explanation for previously obtained associations between disorganization and ADHD symptoms may be "pseudo-disorganization", rather than a relational history (Main & Solomon, 1990). For example, children with high levels of ADHD symptoms have been found to produce less coherent narratives and to include more negative content, even in neutral stories, possibly resulting in a spurious relation between disorganization and ADHD symptoms (Scholtens et al., 2014). Pharmacological treatment of ADHD has also been found to lead to large reductions in rates of disorganization in representational measures of attachment (Storebø, et al., 2014). These findings, taken together with the theoretical proposition by Nigg (2006), suggest that the link between disorganization and ADHD symptoms may depend on comorbid conduct problems. More research on disorganization in relation to ADHD symptoms is however warranted, preferably using longitudinal designs to address the process direction.

Limitations

One limitation was the use of only parental ratings of emotional functioning and externalizing behavior problems, which has been found to be less reliable than teacher ratings for externalizing behavior problems (Oosterlaan et al., 2005). However, the paradigm used allows for separation of emotion regulation and emotionality (Rydell et al., 2003), and parents are considered to have substantial experience of their children´s ability to regulate emotions as well as their emotionality. This is important since it is difficult to separate emotion regulation from emotionality in laboratory based tasks and to systematically activate targeted emotions (Cole et al., 2004). Future studies should however attempt to investigate emotion regulation with observational measures to compliment this line of research.

The study used a dimensional perspective and a relatively large sample size, which should increase the power of finding even small significant associations. We nonetheless acknowledge the possibility that some of the non-significant associations, for example the non-significant association between cognitive inhibition and conduct problems, may be due to power issues because of the relatively low levels of ADHD symptoms and conduct problems in the present sample.

Conclusions

The present study simultaneously examined the contributions of several important domains of functioning in relation to ADHD symptoms and conduct problems, accounting for symptom overlap. Our findings emphasize theoretical models of multiple pathways to ADHD (Nigg, 2006), with cognitive inhibition, regulation of positive emotion and positive emotionality as independent and specific contributors to ADHD symptoms. In contrast, disorganized attachment and negative emotionality emerged as contributing specifically to conduct problems. Previously obtained associations between ADHD symptoms, disorganized attachment, and negative emotionality may therefore depend on comorbid conduct problems. Our study demonstrates the importance of disentangling key deficits specific for ADHD

symptoms and conduct problems, to help develop more focused interventions targeting each of these often unified yet diverse externalizing disorders.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-TR.* (4th ed., text revision.). Washington DC: American Psychiatric Association.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychological Bulletin*, *121*(1), 65. doi: 10.1037/0033-2909.121.1.65

Berlin, L., & Bohlin, G. (2002). Response inhibition, hyperactivity, and conduct problems among preschool children. *Journal of Clinical Child and Adolescent Psychology*, *31*(2), 242-251. doi:10.1207/S15374424JCCP3102_09

Berlin, L., Bohlin, G., Nyberg, L., & Janols, L. O. (2004). How well do measures of inhibition and other executive functions discriminate between children with ADHD and controls? *Child Neuropsychology*, *10*(1), 1-13. doi:10.1076/chin.10.1.1.26243

Bernier, A., Carlson, S. M., Deschênes, M., & Matte-Gagné, C. (2012). Social factors in the development of early executive functioning: a closer look at the caregiving environment. *Developmental Science*, *15*(1), 12-24. doi: 10.1111/j.1467-7687.2011.01093.x

Bohlin, G., Eninger, L., Brocki, K. C., & Thorell, L. B. (2012). Disorganized attachment and inhibitory capacity: predicting externalizing problem behaviors. *Journal of Abnormal Child Psychology*, *40*(3), 449-458. doi: 10.1007/s10802-011-9574-7

Broberg, A., Wiberg, C., & Karlsson, S. (2000). *Separations Ångest Testet (SÅT) [The Separation Anxiety Test (SAT)]*. Unpublished manuscript. Dept of Psychology, Goteborg University, Sweden.

Brocki, K. C., & Bohlin, G. (2006). Developmental change in the relation between executive functions and symptoms of ADHD and co-occurring behaviour problems. *Infant and Child Development, 15*(1), 19-40. doi: 10.1002/icd.413

Brocki, K. C., Nyberg, L., Thorell, L. B., & Bohlin, G. (2007). Early concurrent and longitudinal symptoms of ADHD and ODD: Relations to different types of inhibitory control and working memory. *Journal of Child Psychology and Psychiatry*, *48*(10), 1033-1041. doi:10.1111/j.1469-7610.2007.01811.x

Bunford, N., Evans, S. W., Becker, S. P., & Langberg, J. M. (2014). Attention-deficit/hyperactivity disorder and social skills in youth: A moderated mediation model of emotion dysregulation and depression. *Journal of Abnormal Child Psychology, 43(2),* 283-296. doi: 10.1007/s10802-014-9909-2

Carlson, E. A. (1998). A prospective longitudinal study of attachment disorganization/disorientation. *Child development*, *69*(4), 1107-1128. doi: 10.2307/1132365

Carlson, S. M., & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development, 22*(4), 489-510. doi:10.1016/j.cogdev.2007.08.002

Cassidy, J. (1994). Emotion regulation: Influences of attachment relationships. *Monographs of the Society for Research in Child Development, 59*(2-3), 228-249. doi: 10.1111/j.1540-5834.1994.tb01287.x

Cole, P. M., Martin, S. E., & Dennis, T. A. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development, 75*(2), 317-333. doi:10.1111/j.1467-8624.2004.00673.x

DeOliveira, C. A., Bailey, H. N., Moran, G., & Pederson, D. R. (2004). Emotion socialization as a framework for understanding the development of disorganized attachment. *Social Development, 13*(3), 437-467. doi: 10.1111/j.1467-9507.2004.00276.x

Dodge, K. A., & Pettit, G. S. (2003). A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental Psychology, 39*(2), 349. doi: 10.1037/0012-1649.39.2.349

DuPaul, G. J., Thomas, J., & Anastopoulos, A. D. (1998). *ADHD rating scale-iv: Checklists, Norms, and Clinical Interpretation*. New York: Guilford Press.

Eisenberg, N., Cumberland, A., Spinrad, T. L., Fabes, R. A., Shepard, S. A., Reiser, M., ... & Guthrie, I. K. (2001). The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child Development, 72*(4), 1112-1134. doi:10.1111/1467-8624.00337

Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annual review of clinical psychology, 6*, 495-525. doi: 10.1146/annurev.clinpsy.121208.131208

Fearon, R. P., Bakermans-Kranenburg, M. J., Van IJzendoorn, M. H., Lapsley, A. M., & Roisman, G. I. (2010). The Significance of Insecure Attachment and Disorganization in the Development of Children's Externalizing Behavior: A Meta-Analytic Study. *Child development*, *81*(2), 435-456. doi: 10.1111/j.1467-8624.2009.01405.

Frazier, T. W., Youngstrom, E. A., & Naugle, R. I. (2007). The latent structure of attention-deficit/hyperactivity disorder in a clinic-referred sample. *Neuropsychology, 21*(1), 45. doi: 10.1037/0894-4105.21.1.45

Frick, P. J., & Morris, A. S. (2004). Temperament and developmental pathways to conduct problems. *Journal of Clinical Child and Adolescent Psychology, 33*(1), 54-68. doi:10.1207/S15374424JCCP3301_6

George, C., & Solomon, J. (2000). *Six-Year Attachment Doll Play Classification System.* Unpublished classification manual. Oakland: Mills College.

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3 1/2–7 years old on a stroop-like day-night test. *Cognition, 53*(2), 129-153. doi:10.1016/0010-0277(94)90068-X

Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J.J Gross (Ed.), *Handbook of Emotion Regulation* (pp. 3-24). New York, NY: Guilford Press.

Grossmann, K., Grossmann, K.E., Fremmer-Bombik, E., Kindler, H., Scheurer-Englisch, H., & Zimmermann, P. (2002). The uniqueness of the child-father attachment relationship: Fathers' sensitive and challenging play as a pivotal variable in a 16-year longitudinal study. *Social Development, 11,* 307-331. doi: 10.1111/1467-9507.00202

Haslam, N., Williams, B., Prior, M., Haslam, R., Graetz, B., & Sawyer, M. (2006). The latent structure of attention-deficit/hyperactivity disorder: a taxometric analysis. *Australian and New Zealand Journal of Psychiatry*, *40*(8), 639-647. doi:10.1080/j.1440-1614.2006.01863.x

Hesse, E., & Main, M. (2000). Disorganized infant, child, and adult attachment: Collapse in behavioral and attentional strategies. *Journal of the American Psychoanalytic Association*, *48*(4), 1097-1127. doi: 10.1177/00030651000480041101

Hobson, C. W., Scott, S., & Rubia, K. (2011). Investigation of cool and hot executive function in ODD/CD independently of ADHD. *Journal of Child Psychology and Psychiatry*, *52*(10), 1035-1043. doi: 10.1111/j.1469-7610.2011.02454.x

Hughes, C., & Ensor, R. (2011). Individual differences in growth in executive function across the transition to school predict externalizing and internalizing behaviors and self-perceived academic success at 6 years of age. *Journal of Experimental Child Psychology*, *108*(3), 663-676. doi:10.1016/j.jecp.2010.06.005

Jacobsen, T., & Hofmann, V. (1997). Children's attachment representations: longitudinal relations to school behavior and academic competency in middle childhood and adolescence. *Developmental Psychology, 33*(4), 703. doi: 10.1037/0012-1649.33.4.703

Kaplan, N. (1987). *Individual differences in 6-years olds' thoughts about separation: Predicted from attachment to mother at age 1* (Unpublished doctoral dissertation), University of California, Berkeley, California: Department of Psychology.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.

Lyons-Ruth, K., Easterbrooks, M., & Cibelli, C. D. (1997). Infant attachment strategies, infant mental lag, and maternal depressive symptoms: predictors of internalizing and externalizing problems at age 7. *Developmental Psychology, 33*(4), 681. doi: 10.1037/0012-1649.33.4.681

Maedgen, J.W., & Carlson, C. L. (2000). Social functioning and emotional regulation in the attention deficit hyperactivity disorder subtypes. *Journal of Clinical Child Psychology, 29*(1), 30-42. doi:10.1207/S15374424jccp2901_4

Main, M., Hesse, E., & Kaplan, N. (2005). Predictability of attachment behavior and representational processes at 1, 6, and 19 years of age. In K.E. Grossman, K. Grossman, & E. Waters (Eds.), *Attachment from infancy to adulthood: The major longitudinal studies*, 245-304. New York, NY: Guilford Press.

Main, M., Kaplan, N., & Cassidy, J. (1985). Security in Infancy, Childhood, and Adulthood: A Move to the Level of Representation. *Monographs of the Society for Research in Child Development, 50*(1/2), 66–104. doi: 10.2307/3333827

Main, M., & Solomon, J. (1990). Procedures for identifying infants as disorganized/disoriented during the Ainsworth Strange Situation. In M.T. Greenberg,

D Cicchetti, & E.M. Cummings (Eds.), *Attachment in the preschool years: Theory, Research, and Intervention* (pp. 121-160). Chicago: The University of Chicago Press.

Malmberg, M., Rydell, A. M., & Smedje, H. (2003). Validity of the Swedish version of the Strengths and Difficulties Questionnaire (SDQ-Swe). *Nordic Journal of Psychiatry*, *57*(5), 357-363. doi:10.1080/08039480310002697

Marcus, D. K., & Barry, T. D. (2011). Does attention-deficit/hyperactivity disorder have a dimensional latent structure? A taxometric analysis. *Journal of Abnormal Psychology, 120*, 427–442. doi: 10.1037/a0021405

Martel, M. M. (2009). Research Review: A new perspective on attention-deficit/hyperactivity disorder: emotion dysregulation and trait models. *Journal of Child Psychology and Psychiatry*, *50*(9), 1042-1051. doi:10.1111/j.1469-7610.2009.02105.x

Martel, M. M., & Nigg, J. T. (2006). Child ADHD and personality/temperament traits of reactive and effortful control, resiliency, and emotionality. *Journal of Child Psychology and Psychiatry, 47*(11), 1175-1183. doi: 10.1111/j.1469-7610.2006.01629.x

Melnick, S. M., & Hinshaw, S. P. (2000). Emotion regulation and parenting in AD/HD and comparison boys: Linkages with social behaviors and peer preference. *Journal of Abnormal Child Psychology, 28*(1), 73-86. doi: 10.1023/A:1005174102794

Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., ... & Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences*, *108*(7), 2693-2698. doi: 10.1073/pnas.1010076108

Mullin, B., & Hinshaw, S. (2007). Emotion regulation and externalizing disorders in children and adolescents. In Gross, J. J. (Ed.), *Handbook of emotion regulation* (pp. 523-541). New York: Guilford Press.

Musser, E. D., Galloway-Long, H. S., Frick, P. J., & Nigg, J. T. (2013). Emotion regulation and heterogeneity in attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *52*(2), 163-171. doi:10.1016/j.jaac.2012.11.009

Nigg, J. T. (2001). Is ADHD a disinhibitory disorder? *Psychological Bulletin, 127*(5), 571-598. doi: 10.1037/0033-2909.127.5.571

Nigg, J. T. (2003). Response inhibition and disruptive behaviors. *Annals of the New York Academy of Sciences, 1008*(1), 170-182. doi: 10.1196/annals.1301.018

Nigg, J. T. (2006). *What causes ADHD? Understanding what goes wrong and why*. New York, NY: Guilford Press.

Nigg, J. T., Goldsmith, H. H., & Sachek, J. (2004). Temperament and attention deficit hyperactivity disorder: The development of a multiple pathway model. *Journal of Clinical Child and Adolescent Psychology*, *33*(1), 42-53. doi:10.1207/S15374424JCCP3301_5

Nigg, J. T., Willcutt, E. G., Doyle, A. E., & Sonuga-Barke, E. J. (2005). Causal heterogeneity in attention-deficit/hyperactivity disorder: do we need neuropsychologically impaired subtypes? *Biological Psychiatry*, *57*(11), 1224-1230. doi:10.1016/j.biopsych.2004.08.025

Oosterlaan, J., Logan, G. D., & Sergeant, J. A. (1998). Response inhibition in AD/HD, CD, comorbid AD/HD+ CD, anxious, and control children: A meta-analysis of studies with the stop task. *Journal of Child Psychology and Psychiatry*, *39*(3), 411-425. doi: 10.1111/1469-7610.00336

Oosterlaan, J., Scheres, A., & Sergeant, J. A. (2005). Which executive functioning deficits are associated with AD/HD, ODD/CD and comorbid AD/HD+ ODD/CD? *Journal of Abnormal Child Psychology*, *33*(1), 69-85. Doi: 10.1007/s10802-005-0935-y

Polanczyk, G., de Lima, M. S., Horta, B. L., Biederman, J., & Rohde, L. A. (2007). The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *The American Journal of Psychiatry*, *164*(6), 942-948. doi: 10.1176/ajp.2007.164.6.942

Rubia, K., Halari, R., Smith, A. B., Mohammad, M., Scott, S., & Brammer, M. J. (2009). Shared and disorder-specific prefrontal abnormalities in boys with pure attention-deficit/hyperactivity disorder compared to boys with pure CD during interference inhibition and attention allocation. *Journal of Child Psychology and Psychiatry*, *50*(6), 669-678. doi: 10.1111/j.1469-7610.2008.02022.x

Rubia, K., Smith, A., Halari, R., Matsukura, F., Mohammad, M., Taylor, E., & Brammer, M. (2009). Disorder-specific dissociation of orbitofrontal dysfunction in boys with pure conduct disorder during reward and ventrolateral prefrontal dysfunction in boys with pure ADHD during sustained attention. *American Journal of Psychiatry*, *166*(1), 83-94. doi: 10.1176/appi.ajp.2008.08020212

Rydell, A. M., Berlin, L., & Bohlin, G. (2003). Emotionality, emotion regulation, and adaptation among 5-to 8-year-old children. *Emotion*, *3*(1), 30. doi: 10.1037/1528-3542.3.1.30

Rydell, A. M., Thorell, L. B., & Bohlin, G. (2007). Emotion regulation in relation to social functioning: An investigation of child self-reports. *European Journal of Developmental Psychology*, *4*(3), 293-313. doi: 10.1080/17405620600783526

Scholtens, S., Rydell, A. M., Bohlin, G., & Thorell, L. B. (2014). ADHD symptoms and attachment representations: Considering the role of conduct problems, cognitive deficits and narrative responses in non-attachment-related story stems. *Journal of Abnormal Child Psychology*, 42, 1033-1042. doi: 10.1007/s10802-014-9854-0

Schuengel, C., Bakermans-Kranenburg, M. J., & Van IJzendoorn, M. H. (1999). Frightening maternal behavior linking unresolved loss and disorganized infant attachment. *Journal of Consulting and Clinical Psychology*, *67*(1), 54. doi: 10.1037/0022-006X.67.1.54

Sergeant, J. A., Geurts, H., & Oosterlaan, J. (2002). How specific is a deficit of executive functioning for attention-deficit/hyperactivity disorder? *Behavioural Brain Research*, *130*(1), 3-28. doi: 10.1016/S0166-4328(01)00430-2

Seymour, K. E., Chronis-Tuscano, A., Iwamoto, D. K., Kurdziel, G., & MacPherson, L. (2014). Emotion regulation mediates the association between ADHD and depressive symptoms in a community sample of youth. *Journal of Abnormal Child Psychology*, *42*(4), 611-621. doi: 10.1007/s10802-013-9799-8

Sjöwall, D., Roth, L., Lindqvist, S., & Thorell, L. B. (2013). Multiple deficits in ADHD: executive dysfunction, delay aversion, reaction time variability, and emotional deficits. *Journal of Child Psychology and Psychiatry*, *54*(6), 619-627. doi: 10.1111/jcpp.12006

Sonuga-Barke, E. J. (2005). Causal models of attention-deficit/hyperactivity disorder: from common simple deficits to multiple developmental pathways. *Biological Psychiatry*, *57*(11), 1231-1238. doi: 10.1016/j.biopsych.2004.09.008

Sroufe, L. A., Egeland, B., Carlson, E. A., & Collins, W. A. (2009). *The development of the person: The Minnesota study of risk and adaptation from birth to adulthood*. New York, NY: Guilford Press.

Storebø, O. J., Skoog, M., Rasmussen, P. D., Winkel, P., Gluud, C., Pedersen, J., ... & Simonsen, E. (2014). Attachment Competences in Children With ADHD During the Social-Skills Training and Attachment (SOSTRA) Randomized Clinical Trial. *Journal of Attention Disorders*, *19*(10), 865-871. doi: 10.1177/1087054713520220

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Needham Heights: Allyn & Bacon.

Thorell, L. B., Rydell, A. M., & Bohlin, G. (2012). Parent–child attachment and executive functioning in relation to ADHD symptoms in middle childhood. *Attachment & Human Development*, *14*(5), 517-532. doi: 10.1080/14616734.2012.706396

Thorell, L. B., & Wåhlstedt, C. (2006). Executive functioning deficits in relation to symptoms of ADHD and/or ODD in preschool children. *Infant and Child Development*, *15*(5), 503-518. doi: 10.1002/icd.475

Tillman, C., Brocki, K. C., Sørensen, L., & Lundervold, A. J. (2015). A Longitudinal Examination of the Developmental Executive Function Hierarchy in Children With Externalizing Behavior Problems. *Journal of Attention Disorders*, *19*(6), 495-506. doi: 10.1177/1087054713488439

van IJzendoorn, M. H., Schuengel, C., & Bakermans–Kranenburg, M. J. (1999). Disorganized attachment in early childhood: Meta-analysis of precursors, concomitants, and sequelae. *Development and Psychopathology*, *11*(02), 225-250.

Walcott, C. M., & Landau, S. (2004). The relation between disinhibition and emotion regulation in boys with attention deficit hyperactivity disorder. *Journal of Clinical Child and Adolescent Psychology*, *33*(4), 772-782. doi: 10.1207/s15374424jccp3304_12

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: a meta-analytic review. *Biological Psychiatry*, *57*(11), 1336-1346. doi: 10.1016/j.biopsych.2005.02.006

Table 1

Descriptive Statistics for Child Age, Parental Educational Level, Cognitive Inhibition, Emotion Regulation, Emotionality, Attachment, and Ratings of Externalizing Behavior Problems, N=183-184.

Variables	Minimum	Maximum	*M*	*SD*
Child Age	74	86	82.23	1.77
Parental Educational Level	2	5	4,55	.85
Cognitive Inhibition[a]	-2.94	1.82	.00	1
Regulation of Positive Emotion	1	5	3.40	.84
Positive Emotionality	2	5	3.80	.75
Regulation of Negative Emotion[b]	1.83	5	3.62	.65
Negative Emotionality[b]	1	4.67	2.48	.80
Disorganized Attachment	0	1	.14	.35
Attachment security/insecurity	0	1	.48	.50
ADHD Symptoms	0	1.71	.63	.40
Conduct problems	0	1.2	.33	.34

[a]Standardized aggregated measure of Go/no-go and Day-night stroop.
[b]Mean for anger, sadness, and fear.

Table 2

Bivariate Correlations (r) Between Measures of Cognitive Inhibition, Attachment, Emotion Regulation, Emotionality, and Externalizing Behavior Problems.

	1	2	3	4	5	6	7	8	9
1 Cognitive Inhibition[a]		.12	-.00	.06	-.08	-.25*	.13	-.26***	-.14^{+}
2 Regulation of Positive Emotion			-.31***	.38***	-.30***	-.13^{+}	-.04	-.52***	-.39***
3 Positive Emotionality				-.07	.39***	.05	.12	.43***	.24**
4 Regulation of Negative Emotion[b]					-.54***	-.01	-.13^{+}	-.28***	-.42***
5 Negative Emotionality[b]						.01	.14^{+}	.45***	.62***
6 Disorganized Attachment							-.39***	.16*	.16*
7 Attachment security/insecurity								.06	.00
8 ADHD Symptoms									.52**
9 Conduct Problems									

[a] Standardized aggregated measure of Go/no-go and Day-night stroop.
[b] Mean for anger, sadness, and fear.
$^{+}$ p < .10, * p < .05, ** p < .01, *** p < .001

Table 3

Standardized Beta Scores for Regression Analyses Predicting ADHD Symptoms and Conduct Problems, with and without Control for Comorbid Conduct Problems/ADHD Symptoms.

Variables	ADHD symptoms	ADHD symptoms, With control for Conduct Problems	Conduct problems	Conduct problems, With control for ADHD symptoms
Cognitive Inhibition[a]	- .18**	- .17**	.	.
Regulation of Positive Emotion	- .36***	- .31***	- .21**	- .11
Positive Emotionality	.22*	.23***	- .05	- .11^{+}
Regulation of Negative Emotion[b]	.02	.04	- .05	- .06
Negative Emotionality	.25**	.11	.55***	.48***
Disorganized Attachment	.05	.02	.13*	.11*

[a]Standardized and aggregated measure of Go/no-go and Day-night stroop.
[b]Standardized and aggregated measure of anger, sadness, and fear.
$^{+}$ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$