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Peer Rejection and Attention Deficit Hyperactivity Disorder Symptoms: Reciprocal Relations Through Ages 4, 6, and 8

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Attention deficit hyperactivity disorder (ADHD) predicts poor peer relationships. What remains unclear is whether poor peer relationships affect ADHD symptomatology. Hence, reciprocal effects of peer rejection and ADHD symptoms were examined in a community sample of 962 Norwegian children at ages 4, 6, and 8. Results showed that ADHD symptoms at age 4 predicted more peer rejection at age 6, and that peer rejection at age 4 predicted more symptoms at age 6. However, when conducting analyses on ADHD subtypes, hyperactivity-impulsivity and inattentiveness symptoms were adversely affected by peer rejection at ages 6 and 8, whereas peer rejection was unaffected by such symptoms, indicating that the effect of peer rejection on ADHD symptoms was most robust. Mediation relations were also identified.

Attention deficit hyperactivity disorder (ADHD) in childhood is associated with poor peer relationships (Bagwell, Molina, Pelham, & Hoza, 2001). Children with ADHD have fewer friends and are more socially rejected than their peers without the diagnosis (Mrug et al., 2012). Dysfunctions in establishing enduring social relationships among children with ADHD are presumed to be rooted in the overactive, inattentive, and impulsive behavior associated with the diagnosis (Barkley, 1997; Nigg, 2001; Sonuga-Barke, 2002). Young children with ADHD tend to be unpredictable and egocentric in their play, and they also exhibit more externalizing problems, which makes them less attractive as play partners (Hoza, 2007; Rosen et al., 2014).

The development of ADHD is presumed to be determined primarily by biological factors, including genetics. Indeed, the heritability of ADHD is estimated to be 60%–80% (Larsson, Larsson, & Lichtenstein, 2004). This factor may explain why few studies have investigated to what extent the development of ADHD is linked to social experiences in early childhood. However, as Thapar, Cooper, Jefferies, and Stergiakouli (2012)

emphasized in their review of biological, social, and environmental causes of ADHD, it would be a mistake to focus future research exclusively on biological factors.

The indirect evidence that ADHD may be affected by peer rejection can be found in experimental studies on social rejection and self-regulation, which suggest that social rejection undermines executive functioning, such as attentive abilities, self-control, and even intelligence (Baumeister, DeWall, Ciarocco, & Twenge, 2005; Baumeister, Twenge, & Nuss, 2002). This line of research is based on the idea that socially rejected individuals allocate their cognitive resources to the task of coping with the unsatisfactory situation via, for example, the suppression of negative affect or by generating strategies that may reinstate their social inclusion (Baumeister & Leary, 1995; Maner, DeWall, Baumeister, & Schaller, 2007). Accordingly, under circumstances of more or less chronic social exclusion, fewer cognitive resources will be available for the execution of other tasks. For example, a child who experiences being bullied at school may have difficulties concentrating on a subsequent reading comprehension task in class, due to the

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distracting thoughts and feelings that follow the experience of being victimized (Buhs, Ladd, & Herald, 2006). Over time, such difficulties may be internalized as distinctive response patterns, and as such, they become incorporated into the self as a personality characteristic (Crick, 1996; Parker & Asher, 1987).

Although this line of research is related to self-regulation in the community and not ADHD per se, it has been argued that regulatory capacities among children with ADHD are not qualitatively different from those without the diagnosis, but only poorer (Coghill & Sonuga-Barke, 2012). As such, findings on the interplay between social relationships and self-regulation among children may be generally relevant for children with the ADHD diagnosis.

Several recent studies have demonstrated that peer rejection has an adverse effect on the development of self-regulative abilities in early childhood (Dodge et al., 2003; Nesdale & Lambert, 2008; Stenseng, Belsky, Skalicka, & Wichstrøm, 2014, 2015). Accordingly, it has been speculated that childhood peer rejection—among those vulnerable to its adverse effects—may initiate a self-enforcing process, which involves poorer self-regulation, impaired development of social skills, and increased social rejection (Bukowski, Laursen, & Hoza, 2010; Leary, Kowalski, Smith, & Phillips, 2003). Such *cascade effects* (Masten & Cicchetti, 2010) are normally investigated using mediational analyses, which are preferably conducted on data with three or more measure points (Cole & Maxwell, 2003).

To the best of our knowledge, few studies have investigated the bidirectional relation between long-term peer rejection and the development of ADHD among young children. The most relevant study was perhaps conducted by Tseng, Kawabata, Gau, and Crick (2014), who tested reciprocal models of peer functioning (peer rejection, peer acceptance, and number of friends) and ADHD symptoms in a three-wave, short-term, longitudinal study (12 months) among Taiwanese children ages 10–12. The results showed that peer rejection, in particular, predicted more ADHD symptoms (both hyperactivity–impulsivity and inattentiveness). However, as a limitation to their study, they did not conduct mediational analyses to test the negative self-enforcing process just highlighted.

Taking the advantage of a large, prospective, community study that monitored children transitioning to elementary school and to Grade 3 (age 8), including data from parents and teachers, we tested the hypothesis that symptoms of ADHD

predict increased peer rejection and, reciprocally, that peer rejection predicts increases in ADHD symptoms. First, we tested a model with ADHD symptoms as a unified construct; subsequently, we tested the differential effects between hyperactivity–impulsivity and inattentiveness symptoms by splitting them into separate variables. To test for *cascade effects* in the sample, mediational analyses were performed. Specifically, we tested whether the effect from peer rejection at age 4 to peer rejection at age 8 was amplified by demonstrating more ADHD symptoms at age 6. Additionally, we tested whether the effect from ADHD symptoms at age 4 on such symptoms at age 8 was amplified by peer rejection at age 6. The mediation effects were tested separately for hyperactivity–impulsivity and inattentiveness symptoms. The mediational effects between the two ADHD dimensions were also tested. Finally, we analyzed to what extent these models differed between boys and girls.

Method

Participants and Procedure

The first wave of the Trondheim Early Secure Study was conducted in 2007 and 2008 (T1) and included participants from two birth cohorts of children (born in 2003 or 2004) whose parents lived in Trondheim, Norway. Of the 1,250 Norwegian-speaking children who were recruited to participate in the study, we tested 995 at the time of study enrollment ($M_{\text{age}} = 4.55$ years; 50.6% boys). At T1, 81% of the children were accompanied by their mothers to the clinic, more than 99% of the children were of Western ethnic origin (e.g., Europe, United States), and 86% of their parents lived together. More details concerning the procedure, recruitment, and sample are presented elsewhere (Wichstrøm et al., 2012). The dropout rate did not vary according to the child's mental health (as measured using the Strengths and Difficulties Questionnaire; Goodman, 1997; $\chi^2 = 5.70$, $df = 3$, $p = .13$) or gender ($\chi^2 = 0.23$, $df = 1$, $p = .63$). A total of 752 (50.5% boys) children participated in the follow-up assessment (T2) 2 years later, resulting in a longitudinal participation rate of 75.6% ($M_{\text{age}} = 6.72$ years). At the second follow-up (T3), 661 children participated ($M_{\text{age}} = 8.80$ years; 48.7% boys), which corresponded to a participation rate of 87.9%. The parental data were collected by means of interviews and questionnaires. The teacher data were collected by means of questionnaires sent to day-care centers at T1 and to primary schools at T2 and T3. The

response rates among teachers were 90.6% at T1, 92.2% at T2, and 85.8% at T3. The preschool teachers had known the child for an average of 13 months, whereas the school teachers had known the child for an average of 6 months at T2 and 2½ years at T3. The teachers provided information on peer rejection and the parents provided information on ADHD symptoms on all three measurement occasions. Regarding clustering effects, there were only 3 children on average from each classroom who participated in the study, resulting in small design effects for teacher reported measures (range = 1.2–1.6). Hence, the clustering of children within classrooms did not warrant a multilevel analysis.

Measures

Peer Rejection

The Teacher Report Form (TRF) from the Achenbach System of Empirically Based Assessment (Achenbach & Rescorla, 2000) was used to assess peer rejection. According to Asher and Coie (1990) and others (Ladd, 2006; Reijntjes et al., 2010), six items from the TRF reflecting peer rejection were identified and subsequently explored using the factor and reliability analyses. Three items were finally chosen according to the criteria of face validity and statistical reliability: not liked by other children/pupils, doesn't get along with other children/pupils, and gets teased a lot. The teachers rated each item for each child using a 3-point scale ranging from 0 (*not true*), 1 (*somewhat or sometimes true*), to 2 (*very true or often true*). Cronbach's alphas for the construct were .73 at T1, .68 at T2, and .76 at T3. The scale correlated moderately high using the Revised Olweus Victimization Scale (Kyriakides, Kaloyirou, & Lindsay, 2006) at T2 ($r = .58$, $p < .001$), which measures a broader range of peer rejection (including physical abuse).

ADHD Symptoms

The Preschool Age Psychiatric Assessment/Child and Adolescent Psychiatric Assessment (PAPA/CAPA; Angold & Costello, 2000; Egger et al., 2006) is a semistructured diagnostic interview developed for assessing *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. (*DSM-IV*) diagnoses (American Psychiatric Association, 1994). The interview follows a structured protocol using parents as informants. Whenever a symptom is reported that meets the criteria for a *DSM* diagnosis, the interviewer separately records the frequency, duration,

and date of onset of each symptom. The symptoms are organized according to three dimensions of ADHD: hyperactivity, impulsivity, and inattentiveness. According to the *DSM-IV* and *DSM-V*, we computed *hyperactivity-impulsivity* and an *inattention* scale consisting of the respective symptoms. In the present study, the interviewers ($n = 7$) had at least a bachelor's degree in a relevant field and underwent training by the team that developed the PAPA/CAPA. To calculate the interrater reliability, the audio of 9% of the interviews was recoded by pairs of blinded raters. The reliability (intraclass correlation [ICC]) for multiple pairs of blinded raters was .96 for ADHD, as measured by PAPA (ages 4 and 6), and .90 for CAPA (age 8).

Results

The descriptive statistics (mean values and standard deviations) of the study variables are presented in Table 1. The mean levels of peer rejection significantly increased from T1 to T3 ($F = 16,326.56$, $df = 1$, $p = .001$). Additionally, inattentiveness symptoms significantly increased from T1 to T2 ($p < .001$) and T3 ($p < .001$), but not from T2 to T3 ($p = 1.00$), $F = 268.58$, $df = 1$, $p < .001$. In contrast, hyperactivity-impulsivity symptoms significantly decreased from T1 to T3 ($p < .001$) as well as from T2 to T3 ($p = .004$, $F = 274.06$, $df = 1$, $p < .001$).

The reciprocal model was tested using structural equation modeling in Mplus (Muthén & Muthén, 2008), applying a robust maximum likelihood estimator. The missing data were handled according to a full information maximum likelihood procedure. As a preliminary part of these analyses (Kline, 2010), the latent constructs of peer rejection and ADHD symptoms (at T1, T2, and T3) were

Table 1
Mean Values and Standard Deviations of Peer Rejection, Hyperactivity-Impulsivity, and Inattentiveness Symptoms at Ages 4 (T1), 6 (T2), and 8 (T3)

	Age 4 (T1) (N = 995)		Age 6 (T2) (N = 752)		Age 8 (T3) (N = 661)	
	M	SD	M	SD	M	SD
Peer rejection	1.08	0.24	1.10	0.23	1.11	0.27
Hyperactivity-impulsivity symptoms	0.91	1.55	0.84	1.49	0.61	1.45
Inattentiveness symptoms	0.59	1.18	0.80	1.50	0.83	1.48

validated using confirmatory factor analyses. The model fit indices showed that the latent measurement model (i.e., three peer rejection items at each age, and the two subtypes of ADHD symptoms, correlated at each measure point) showed a good fit with the data, $\chi^2 = 121.244$ ($df = 79$, $p < .001$), comparative fit index (CFI) = 0.968, Tucker–Lewis index (TLI) = 0.957, root mean square error of approximation (RMSEA) = 0.023, and standardized root mean square residual (SRMSR) = 0.052 (Hu & Bentler, 1999).

The full structural model, including all potential correlations and autoregressive and cross-lagged paths, was tested (Figure 1). The results for the model showed that in the total sample, more ADHD symptoms at age 4 predicted more peer rejection at age 6 and that more peer rejection at age 4 predicted more ADHD symptoms at age 6. Such a reciprocal relation was not found between ages 6 and 8. When controlling for gender effects, the results showed that boys were more likely to be rejected at T1 ($\beta = .14$, $p < .001$) and that they were more likely to exhibit ADHD symptoms at age 4 ($\beta = .11$, $p = .002$); however, the reciprocal relation remained significant. Furthermore, the Satorra–Bentler chi-square test showed that the overall model did not significantly differ between boys and girls, $\Delta\chi^2(24) = 18.32$, $p = .79$. The model fit indices showed that the full model showed an excellent fit with the data, $\chi^2 = 118.66$ ($df = 73$, $p < .001$), CFI = 0.962, TLI = 0.946, RMSEA = 0.025, SRMR = 0.056.

We investigated whether a different pattern of reciprocal relations emerged when separating hyperactivity–impulsivity and inattentiveness symptoms. When differentiating the subtypes of ADHD in the model, the results showed that more peer rejection at age 4 predicted more hyperactivity–impulsivity and inattentiveness symptoms at age 6, and more

peer rejection at age 6 predicted more hyperactivity–impulsivity and inattentiveness symptoms at age 8. Notably, when separating ADHD symptoms, they did not predict more peer rejection, either at age 6 or at age 8. The results from the analyses are presented in Figure 2 (shown without the gender paths, although they are included in the analyses).

Finally, we investigated whether “cascade effects” could be identified in the model. A full set of potential mediational effects was tested using Mplus (e.g., T1 peer rejection → T2 hyperactivity–impulsivity symptoms → T3 peer rejection, and T1 hyperactivity–impulsivity symptoms, T2 peer rejection, T3 hyperactivity–impulsivity symptoms, and so on). Two significant mediational effects showed the following: (a) the effect of inattentiveness at ages 4–8 was amplified by hyperactivity–impulsivity symptoms at age 6 ($p = .013$), and (b) the effect of peer rejection at age 4 toward hyperactivity–impulsivity symptoms at age 8 was amplified by inattentiveness symptoms at age 6 ($p = .020$).

In summary, the results supported the assumption that ADHD symptoms are predicted by peer rejection. Evidence for a reciprocal relation was identified for ages 4–6 for the total ADHD symptomatology, but not for ages 6–8. Furthermore, the mediational analyses, in part, supported cascade effects related to the two dimensions of ADHD symptoms, but not with respect to the idea that peer rejection may be intensified by ADHD symptoms over time.

Discussion

The primary goal of the present study was to examine the reciprocal effects of peer rejection and ADHD symptoms across a 4-year period, from pre-

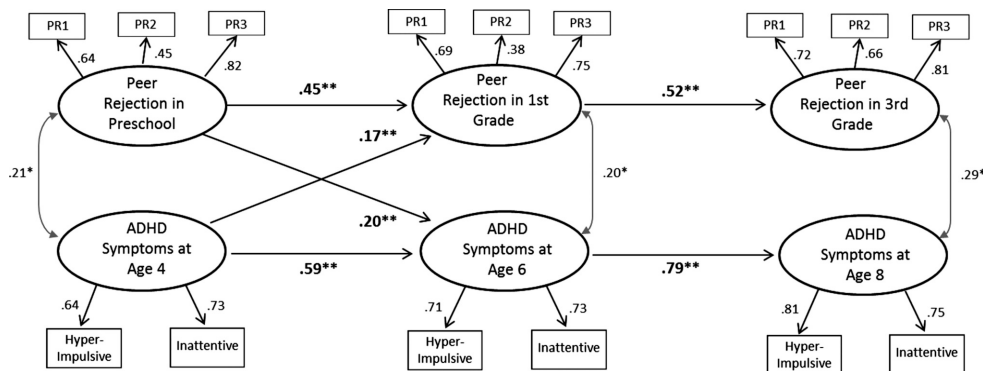


Figure 1. Cross-lagged panel model of peer rejection and attention deficit hyperactivity disorder (ADHD) symptoms (total) at ages 4, 6, and 8. The path coefficients are standardized regression weights (only significant paths are shown).

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

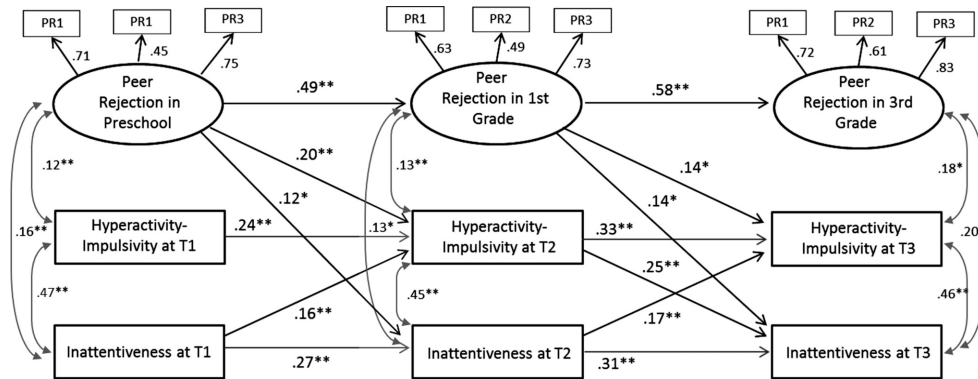


Figure 2. Cross-lagged panel model of peer rejection, hyperactivity–impulsivity, and inattentiveness symptoms at ages 4 (T1), 6 (T2), and 8 (T3). The path coefficients are standardized regression weights (only significant paths are shown).

* $p < .05$, ** $p < .01$.

school to first grade, and then at third grade, spanning from ages 4 to 8. Consistent with prior cross-sectional studies, within-time associations at ages 4, 6, and 8 showed that more ADHD symptoms were associated with greater peer rejection (Bagwell et al., 2001; Hoza, 2007). More importantly, longitudinal analyses revealed reciprocal effects: More peer rejection in preschool predicted more ADHD symptoms at age 6, and more ADHD symptoms at age 4 predicted greater peer rejection at age 6 in school, while controlling for T1 assessments. In other words, preschool children who behaved in a more undercontrolled manner experienced increased peer rejection in school 2 years later, and children who experienced more peer rejection in preschool exhibited increased undercontrolled behaviors in school. The results were compatible with those reported by Tseng et al. (2014), who found that peer rejection predicted hyperactivity–impulsivity and inattentiveness symptoms, although their findings stemmed from a short-term longitudinal study on children of ages 10–12. The results are also consistent with experimental studies on adults and adolescents (Baumeister et al., 2002; Baumeister et al., 2005). Together, these findings indicated that poorly regulated young children are at increased risk of being rejected by their peers, but more importantly, they also show that poor peer relationships negatively affect children’s development of regulatory abilities. However, this interplay did not continue once in school because no such cross-lagged effect was identified from ages 6 to 8.

As reported, we additionally tested the cross-lagged model with the two ADHD subtypes as separate variables, and a more detailed pattern of relations emerged, which has implications for the above null findings concerning the early school-age

period (first to third grades). The results showed that prior peer rejection forecasted more hyperactivity–impulsivity and inattentiveness symptoms at ages 6 and 8. However, neither hyperactivity–impulsivity nor inattentiveness symptoms predicted more peer rejection when separating the constructs. When splitting the ADHD subtypes, the longitudinal effects of peer rejection were more robust than those in the opposite direction, from symptoms toward rejection. This discrepancy regarding treating ADHD as a unified construct in the model is most likely due to loss of statistical power, as well as the inclusion of more measurement error, when using observed scores and not latent variables in the analyses. Moreover, the results indicated that hyperactivity–impulsivity and inattentiveness symptoms are differently affected, depending on age. Hyperactivity–impulsivity was less affected by peer rejection at age 8 compared to age 6, whereas inattentiveness was nearly equally affected at ages 6 and 8. However, this observation may be due to how undercontrolled behavior is exposed in early childhood. As shown by Hart, Lahey, Loeber, Applegate, and Frick (1995), hyperactivity symptoms tend to decrease throughout childhood, whereas inattentiveness symptoms increase, which is also the tendency observed in our sample. Additionally, the effect of hyperactivity–impulsivity symptoms on more inattentiveness symptoms that emerged at age 8 may in part be explained by how ADHD symptoms develop at these ages.

When examining mediational effects, we found that hyperactivity–impulsivity symptoms augmented more inattentiveness symptoms and that hyperactivity–impulsivity enhanced the effect of peer rejection on inattentiveness symptoms. Nevertheless, because none of these effects involved peer rejection as an outcome, the results do not support the idea

that detrimental cascade effects (Masten & Cicchetti, 2010) emerge in the relation between social relationships and behavior problems. However, our data demonstrate that peer rejection predicts more hyperactivity–impulsivity and inattentiveness symptoms and that first-grade hyperactivity–impulsivity mediates the effect of preschool peer rejection on third-grade inattentiveness. One likely explanation for this mediation effect is based on the fact that ADHD symptoms are age dependent. To be more specific, the mediation effect illustrates that preschool peer rejection predicts third-grade inattentiveness problems, which are most evident at that age, but partly through preceding hyperactivity problems at first grade, which are most evident at that particular age. Overall, the present findings are compatible with the outcomes reported by Tseng et al. (2014) in their study among 10- and 12-year-old Taiwanese children, showing that poor peer functioning predicted later ADHD symptoms. Together, these studies highlight that undercontrolled behavior, even when measured as ADHD symptoms, is affected by the social context children experience in their everyday life. Additionally, they suggest that similar effects are observable at different ages. Finally, because similar results emerged in Norway and in Taiwan—which have different cultures—these two studies support arguments for the universality of such an effect.

Although sparsely investigated in previous studies—aside from several experimental investigations with adults (Baumeister et al., 2005; Twenge, Baumeister, Tice, & Stucke, 2001)—the present results have proven to be consistent with the notion that the adverse effect of social rejection on self-control becomes most pronounced among children with a poor overall level of self-regulative resources, which often is the case for children with many ADHD symptoms (Barkley, 1997; Nigg, 2001). The present findings harmonize well with the view presented by Thapar et al. (2012) in their review of causes for ADHD, where they conclude that several contextual factors may worsen the development of ADHD, including *psychosocial adversity*, which encompasses peer rejection. However, it should be noted that ADHD and externalized problems overlap substantially in early childhood (Van den Bergh & Marcoen, 2004) and that ADHD symptoms sometimes may be difficult to separate from conduct problems (Thapar, Harrington, & McGuffin, 2001). Therefore, studies designed to detect how different types of undercontrolled behaviors are affected by peer rejection are warranted.

The present findings may be relevant to the interpretation and treatment of overactive behaviors, such as ADHD. Behavioral disorders are well known to be implicated with peer problems, which is also confirmed by the present study; however, one is perhaps less aware of the long-term relations between these elements. Within the actual limits of an observational study, our findings indicated that the symptoms of ADHD are in part affected by how well children function with their peers. Parents, teachers, and clinicians need to be aware of children's experiences with age-mates. A harsh peer milieu in preschool and elementary school may provoke fear and anxiety among certain children (Snyder et al., 2003), which may occasionally manifest itself as restlessness or intrusive behavior among rejected and bullied children (Jensen et al., 2001). Accordingly, the present study indicated that the behavioral consequences of being socially rejected may occasionally manifest as symptoms of ADHD, which often is regarded as a neurological disorder (Thapar et al., 2012). However, in several instances, behavior consistent with the disorder may, in part, be due to a modifiable and preliminary situation, such as being rejected by peers. However, little is known with regard to the underlying psychological processes leading to such an adverse effect of peer rejection on self-regulation, although several explanatory models do exist (Baumeister et al., 2002; Carver, Johnson, & Joormann, 2008; DeWall, Baumeister, Stillman, & Gailiot, 2007), some being linked to biological processes (see Vaillancourt, Hymel, & McDougall, 2013, for a review). A next step would entail tailoring interventions for poorly regulated children that fully acknowledge the importance of peer relationships in developing better self-regulation, especially in schools (Daley et al., 2014).

Several limitations of the current inquiry need to be noted. Although the present study was conducted on a fairly large sample—especially when one considers the quality of the clinical data collected—the number of children within the diagnostic range of ADHD symptoms was small. Therefore, longitudinal analyses were conducted using ADHD symptoms as a continuous measure, instead of comparing groups of children *with* or *without* ADHD based on their symptoms. The findings from the present study consequently cannot be generalized to the population of children with an ADHD diagnosis. Additionally, there are several approaches to the measurement of peer relationships among young children (Nabuzoka, 2003), such as peer nominations (Perren & Alsaker, 2006).

In the present study, we used information from teachers to measure peer rejection by combining items from the TRF. Although this ad hoc measure showed good psychometric properties, a more dedicated measure may have resulted in the emergence of stronger findings. Furthermore, a final limitation concerns the cultural context in which this study took place, that is, Trondheim, Norway. As the present study was conducted in a country with a well-developed welfare system, we acknowledge that the results may not directly transfer to other societies, especially because the frequency of peer rejection may be higher in other countries (Solberg & Olweus, 2003; Wolke, Woods, Stanford, & Schulz, 2001). Nevertheless, together with the study by Tseng et al. (2014) in Taiwan, these findings illustrate how peer relationships are linked to undercontrolled behaviors, such as ADHD symptoms, in early childhood.

Peer rejection and other forms of social marginalization, such as victimization, are common and have long-lasting effects (Arseneault, Bowes, & Shakoor, 2010). Hence, more knowledge regarding their detrimental consequences, such as those in the present study, may be beneficial to implement among parents and teachers. Finally, the present findings emphasize that clinicians working with children who have poor self-regulative abilities should be cognizant of their peer relationships.

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