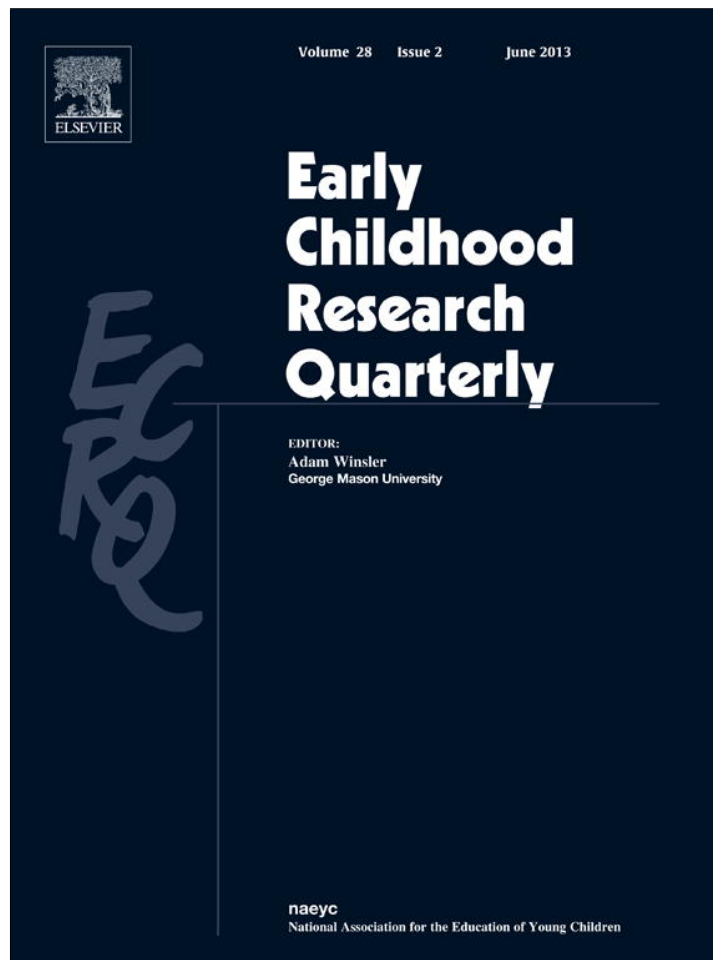


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Mother–child attachment and cognitive performance in middle childhood: An examination of mediating mechanisms

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ABSTRACT

Although mother–child attachment has been shown to predict cognitive performance, there has been a lack of attention to the mediating mechanisms that explain these associations. In the present study, we investigated relations of early mother–child attachment and cognitive performance in middle childhood (the latter in terms of both academic performance and IQ), and potential mediating mechanisms. Mother–child attachment was assessed at 15, 24, and 36-months, and child grades and IQ were assessed at grades 3 and 4. Attachment patterns at 15 months and avoidant attachment at 36-months were not related to school performance or IQ in middle childhood. Children more securely attached at 24 or 36-months had better school performance and higher IQs in middle childhood, and parental quality of assistance, encouragement of academics, children's social relationships, and children's regulatory characteristics significantly mediated these relationships. Both insecure-ambivalent attachment and disorganized attachment predicted later cognitive performance, and these associations were primarily mediated by the quality of parental assistance and child cooperation. This study advances our understanding of how and why early mother–child attachment is related to children's cognitive performance during middle childhood.

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Success in school is linked to later success in several of the tasks of adulthood. For example, higher education is related to higher earnings, a lower unemployment rate, less dependence on public assistance, increased chances of being covered by pensions and health insurance, and lower poverty rates (National Alliance of Business, Inc., 1998). It is therefore important to understand how and why different experiences in childhood are related to children's academic success at school and cognitive development. An important family factor, mother–child attachment, has been related to cognitive performance (Jacobsen & Hofmann, 1997; Moss & St-Laurent, 2001), with securely attached children showing enhanced cognitive performance. It is less clear *why* securely attached children show better cognitive performance. The purpose of this study was to examine the associations between mother–child attachment and cognitive performance, including both academic performance and IQ, and to test potential mediating mechanisms that may explain why early attachment predicts children's later cognitive performance.

Bowlby (1969, 1980) proposed that infants develop an attachment with their primary caregiver (attachment figure), usually the mother, within their first year of life, which continues to be important across childhood. Child–parent attachment differs from other

bonds because it is based on the child's needs for security and protection. The attachment relationship supports both the child's need for close proximity to the caregiver and also the child's need to explore the world (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969, 1980). When the child is anxious, the attachment system is activated, and the child will seek proximity to the attachment figure for comfort instead of exploring the environment. When the child is comfortable, the attachment system is deactivated and the child explores the environment, and therefore the parent–child attachment relationship is an important influence on the child's exploration of and involvement with their surrounding environment, including the school environment (O'Connor & McCartney, 2007). Although all children become attached to their caregivers, there are variations in the security of attachments. When parents provide sensitive and responsive care, their children are more securely attached. By definition, a child who is securely attached is able to use the parent as both a source of comfort (safe haven) and as a secure base from which to explore the environment, and will develop positive mental representations, or *internal working models* (IWMs; i.e., Ainsworth et al., 1978; Bowlby, 1969, 1980; Sroufe, 1988; Weinfield, Sroufe, Egeland, & Carlson, 2008), which capture expectations and beliefs about the self (e.g., whether the child is worthy of attention and care) and others (e.g., whether others are likely to be responsive and available).

A key tenet of attachment theory is that the security of a child's attachment to caregivers has implications for the child's

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later development. Bowlby (1969, 1980) highlighted the importance of attachments to caregivers for a child's later social and personality development (e.g., hostility, self-concept, depression), and there is substantial research suggesting that a more secure attachment in infancy and early childhood is associated with aspects of social development such as more positive relationships with peers, more adaptive coping with stress, and a positive but balanced self-concept (Schneider, Atkinson, & Tardif, 2001; Weinfield et al., 2008). There also has been speculation regarding how strongly attachment might be related to cognitive development, and whether any associations might be accounted for by other variables (Belsky & Cassidy, 1994). Sroufe (1988) suggested that secure attachment might be only weakly related to cognitive development, and even when associations emerge they are likely indirect and due to other associated factors such as responsive parenting. IQ is an aspect of cognitive development that has been conceptualized by some researchers as likely to be unrelated to attachment (e.g., Sroufe, 1988), and studies have even included measures of intelligence to test the discriminant validity of attachment measures (e.g., Granot & Mayseless, 2001; Schmueli-Goetz, Target, Fonagy, & Datta, 2008). By contrast, other researchers have argued that attachment may be an important influence on cognitive development, suggesting that securely attached children could be expected to show better school performance or higher IQ because of their greater exploration of the environment, experiences with a responsive caregiver, support from peers or teachers, and their more positive self-concept (Kerns, 2008; Moss, St-Laurent, Dubois-Comtois, & Cyr, 2005).

The relationship between attachment security and cognitive performance has been studied extensively in early childhood (ages 3–6 years). De Ruiter and van IJzendoorn (1993) reviewed the literature and concluded that securely attached children tend to score higher on indices of cognitive development such as attention, problem solving, and IQ in early childhood. In addition, van IJzendoorn, Dijkstra, and Bus (1995) performed a meta-analysis examining the relationship between attachment and intelligence and language development in early childhood. They found a weak association between attachment and IQ, although attachment was more strongly related to language development.

The association between attachment security and cognitive performance has been investigated to a lesser extent in older children. It is important to investigate these links in middle childhood (ages 6–11 years) given that this is the age period when children begin universal schooling, and school success at this age predicts children's performance at higher grade levels (Duncan et al., 2007). Two indices of cognitive performance, academic performance and IQ, have been examined most frequently in middle childhood (see Table 1). Several studies found that attachment security predicted school performance or academic skills in middle childhood (Aviezer, Resnick, Sagi, & Gini, 2002; Jacobsen & Hofmann, 1997; Kerns, Klepac, & Cole, 1996; Kerns, Tomich, Aspelmeier, & Contreras, 2000; Moss & St-Laurent, 2001; see Granot & Mayseless, 2001, for an exception), although attachment was not always related to every measure of academic performance in a given study. An additional study (Teo, Carlson, Mathieu, Egeland, & Sroufe, 1996) found that a child's early history – an aggregate including attachment security, psychological adjustment, and quality of the psychosocial environment – predicted math achievement in first and sixth grade, after controlling for IQ. The findings are more mixed when examining attachment and IQ in middle childhood. Two studies did not find an association between the two (Moss & St-Laurent, 2001; Schmueli-Goetz et al., 2008), while three other studies did find that secure attachment was related to higher IQ (Jacobsen, Edelstein, & Hofmann, 1994; O'Connor & McCartney, 2007; van IJzendoorn and Vliet-Visser, 1988). In addition, Stams, Juffer, and van IJzendoorn (2002) found that attachment security

measured in infancy predicted an aggregate of both academic performance and IQ in middle childhood. As shown in Table 1, although previous studies assessed attachment security using a variety of approaches (including observational, questionnaire, and representational measures), the differences in attachment measures did not appear to explain the differences in the findings across studies. For example, both representational and observational measures of attachment security have been related to cognitive performance in some studies (e.g., Jacobsen & Hofmann, 1997; van IJzendoorn and Vliet-Visser, 1988) but not others (e.g., Granot & Mayseless, 2001; Moss & St-Laurent, 2001).

In summary, our review of the literature suggests that attachment may be related to academic performance and IQ in middle childhood. At the same time, there are inconsistencies in the findings. One difficulty in comparing across studies is that different investigators used different measures to assess cognitive performance. In addition, many studies only included a single indicator of cognitive performance, either academic performance or IQ. Finally, studies varied considerably in sample size, and thus, in some studies, there may not have been sufficient power to detect smaller effects sizes. In the present study, we investigated the predictive significance of early attachment for cognitive performance in middle childhood. We assessed attachment security at 15, 24, and 36 months of age, and assessed both academic performance and IQ in middle childhood (grades 3 and 4). This allowed us to examine whether attachment showed similar relations to academic performance and IQ when both are assessed in the same sample of children. We were particularly interested in whether attachment would be more strongly related to academic performance than to IQ, given that performance in a school setting might be more affected by personality factors (e.g., cooperation) or relationships outside the family (e.g., teachers or peers). Further, we examined these questions in a large sample, using data from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care (SECC), which gave us adequate statistical power to detect even small effects.

In addition, we were also interested in evaluating hypotheses regarding why attachment and cognitive performance might be associated. As noted earlier, even when attachment and cognitive development are related, it is important to examine what might account for the associations (Sroufe, 1988). As O'Connor and McCartney (2007) note, there has been a lack of research testing possible mechanisms. van IJzendoorn et al. (1995) offered several explanations of why secure attachment may be related to better cognitive performance. The first of these hypotheses was the *attachment-teaching hypothesis*. According to this hypothesis, parents of securely attached children may be better at informally teaching their children (e.g., more attuned to their children), and because of this parenting skill, securely attached children perform better on tests of cognitive ability. There is some support for the teaching hypothesis in that mothers of securely attached children have been found to provide higher-quality assistance during teaching tasks (e.g., Dubois-Comtois, Cyr, & Moss, 2011; Matas, Arend, & Sroufe, 1978), and higher quality of assistance and greater cognitive stimulation by mothers was found to mediate associations between early insecure attachment and IQ at first grade (O'Connor & McCartney, 2007). In the present study, we explored the *attachment-teaching hypothesis* further by testing whether higher quality of maternal assistance explains the link between early mother-child attachment and cognitive performance in third and fourth grade. We also extended earlier work by examining another aspect of parenting, encouragement of schooling. As sensitive parents, mothers of more securely attached children also may be more encouraging of school with their child in the service of supporting their children's success at school. We extended earlier work by testing whether encouragement of a child's scholastics could

Table 1
Mother–child attachment and cognitive performance literature in middle childhood.

Article	N	Age of assessment	Measure of attachment	Measure of DV	Significant effect
Attachment and academic performance in middle childhood					
Aviezer et al. (2002)	66	IV: 13–15 mos., 11–12 yrs. DV: 11–12 yrs.	Strange Situation (SS), Separation Anxiety Test (SAT)	Scholastic skills (Teacher reports); GPA	Yes – SS and SAT predicted scholastic skills. SAT also predicted GPA No – SS did not predict GPA
Granot and Maysel (2001)	113	IV: 4th or 5th grades DV: 4th or 5th grades	Security Scale (Child report), Doll Story Completion Task (Child report)	Academic Achievement Rating Scale (Teacher report); GPA (Teacher report)	No – attachment not related to academic achievement or GPA, after controlling for gender
Jacobsen and Hofmann (1997)	108	IV: 7 yrs. DV: 7, 9, 12, 15 yrs.	Separation Story (Child report)	GPA (Teacher report)	Yes – attachment predicted GPA at all ages
Kerns et al. (1996)	71	IV: 5th grade DV: 5th grade	Security Scale (Child report)	Harter's self-perception scale of scholastic competence (Child report); GPA	Yes – perceived scholastic competence No – GPA
Kerns et al. (2000)	79	IV: 3rd, 6th grades DV: 3rd, 6th grades	Security Scale (Child report), Coping Strategies Questionnaire (Child report), SAT interview (Child report)	Teacher–Child Rating Scale – academic skills aggregate, school adaptation aggregate (Teacher report)	Yes – mother–child attachment related to academic skills and school adaptation at 3rd grade and academic skills at 5th grade
Moss and St-Laurent (2001)	108	IV: 6 yrs. DV: 8 yrs.	Separation – Reunion task	Grades in language and mathematics	Yes – controlling attachment predicted low academic performance No – academic performance of securely and insecurely attached children did not differ
Stams et al. (2002)	146	IV: 12 mos. DV: 7 years	Strange Situation	Cognitive development [aggregate of intelligence, academic performance, learning, attention, and field independence]	No – early parent–child relationship predicted cognitive development, but attachment security was not a significant individual predictor
Teo et al. (1996)	174	IV: 12, 18 mos. DV: 1st, 3rd, 6th grades	Early Psychosocial–developmental History (included Strange Situation among other variables)	Peabody Individual Achievement Test (mathematics, reading comprehension)	Yes – early history predicted math and reading achievement in 1st and 6th grades and reading achievement in 3rd grade
Attachment and IQ in middle childhood					
Jacobsen et al. (1994)	85	IV: 7 yrs. DV: 7, 9, 12, 15 yrs. (IQ at 7 yrs. only)	Separation story	Piagetian task battery, Raven's Progressive Matrices	Yes – attachment related to cognitive functioning and IQ scores
Moss and St-Laurent (2001)	108	IV: 6 yrs. DV: 6, 8 yrs.	Separation – Reunion task	Peabody Picture Vocab Test-Revised; WISC-R block design and vocab subtests	No – no significant differences between attachment groups on IQ were found
O'Connor and McCartney (2007)	1000	IV: 36 mos. DV: 1st grade	Modified Strange Situation	Woodcock–Johnson Psycho-Educational battery-Revised – memory for names, memory for sentences, incomplete words, and picture vocab subscales	Yes – attachment predicted cognitive skills. Ambivalent and insecure/other, but not avoidant or controlling attachment, individually predicted cognitive skills
Schmueli-Goetz et al. (2008)	227	IV: 7–12 yrs. DV: 7–12 yrs.	Children Attachment Interview	Wechsler Intelligence Test for School Children-III UK – similarities, vocabulary, picture arrangement, and block design subscales	No – there were no significant differences between attachment classifications on verbal IQ scores
van IJzendoorn and Vliet-Visser (1988)	77	IV: 24 mos. DV: 5 yrs.	Strange Situation	Leiden Diagnostic test – block design, word span, repeating sentences, picture indicating, and comprehension subscales	Yes – securely attached children had higher IQs than insecurely attached children

also explain associations between attachment and later cognitive performance.

The second hypothesis van IJzendoorn et al. (1995) discussed was the *social-network hypothesis*. They speculated that securely attached children may reference their secure working models when forming new relationships, thus possibly resulting in having more harmonious relationships with teachers and peers, which

in turn could provide more cognitive stimulation. In addition, securely attached children may be more comfortable in the school environment and better able to communicate with teachers and peers (Kerns, 2008), which could foster learning. For example, a securely attached child may be more comfortable expressing their knowledge, or lack thereof, which can lead to a better understanding of concepts and ultimately to better academic success.

There is indirect evidence for the social network hypothesis, in that parent–child relationships are related to the quality of children's relationships with teachers and peers (e.g., Ahnert, Pinquart, & Lamb, 2006; Booth-LaForce & Kerns, 2009; Howes & Spieker, 2008; Myers & Pianta, 2008), and children with higher quality relationships with teachers and peers show greater cognitive performance (e.g., Myers & Pianta, 2008; Wentzel, 2009). In one study directly testing the social network hypothesis, perceptions of teacher support partially mediated the link between attachment quality and academic motivation (Duchesne & Larose, 2007). In a second study (O'Connor & McCartney, 2007), relationships with teachers but not friends mediated associations between insecure attachment and later IQ. We explored the *social-network hypothesis* in this study by testing whether the quality of children's relationships with teachers and their acceptance by peers can explain associations of early attachment with later cognitive performance.

The third hypothesis that may explain the relations between secure attachment and cognitive performance discussed by van IJzendoorn et al. (1995) is the *attachment-cooperation hypothesis*. They suggest that securely attached children are more willing to comply with the demands of school because they experience less anxiety when away from the primary caregiver. Similarly, Jacobsen and Hofmann (1997) proposed that insecurely attached children may have a harder time in the school environment because separation from their primary caregivers induces anxiety and stress which could undermine their ability to benefit from schooling. Securely attached children do show better attention, participation, and communication at school (Jacobsen & Hofmann, 1997; Moss & St-Laurent, 2001; O'Connor & McCartney, 2007; van IJzendoorn et al., 1995), which may explain why securely attached children exhibit better cognitive performance. To test the *attachment-cooperation hypothesis*, we explored the child's work habits and cooperation at school as mediating links between attachment and cognitive performance.

The final hypothesis van IJzendoorn et al. (1995) proposed to explain the link between attachment and cognitive performance was the *self-model* (referred to in this paper as the *self-regulation hypothesis*), which is based on the idea that attachment can contribute to academic performance indirectly through its influence on a child's self-motivation and self-control. Children's ability to restrain and wait is critical for cognitive performance. For example, when children are able to focus their attention and control their behavior it can enhance their learning (O'Connor & McCartney, 2007). To test the *self-regulation hypothesis*, we explored whether the better cognitive performance of securely attached children can be attributed to their inhibitory control or their ability to delay gratification.

To summarize, we used a longitudinal design to test if early attachment security is related to cognitive performance (academic performance and IQ) in middle childhood, and to explore mediating mechanisms. The present study extends an earlier study (O'Connor & McCartney, 2007) that was designed to find potential mediators explaining why parent–child attachment may be related to later cognitive development. O'Connor and McCartney (2007) also utilized the NICHD SECC data set, and they examined factors that might mediate the association between insecure attachment at 36 months and IQ at first grade. We extended their study by examining how attachment at 15, 24, and 36 months was related to both academic performance and IQ later in middle childhood (grades 3 and 4). We examined two mediators evaluated by O'Connor and McCartney (maternal assistance and teacher–child relationships). We also examined additional mediators they did not consider, including parent encouragement of schooling, peer acceptance, child cooperation, and child self-regulation. Lastly, we extended O'Connor and McCartney (2007) by assessing peer acceptance rather than friendship.

Our first question was whether early attachment would predict academic performance and IQ scores at grades 3 and 4. Although this study investigates predictive association of attachment and cognitive performance over a long time interval (longer than most prior studies; see Table 1), we expected that attachment would forecast later academic performance and IQ, with perhaps stronger associations with academic performance. Our second question was whether attachment would be related to our proposed mediators, all of which we expected to be related to attachment. Our third question was whether we would find evidence for mediation. We hypothesized that maternal quality of assistance and encouragement of academics, relationships with teachers and peers, cooperation at school, and self-regulation would mediate the relations between mother–child attachment and cognitive performance in middle childhood.

Finally, a secondary goal of the study was to explore how different forms of insecure attachment (avoidant, ambivalent, disorganized) are related to academic performance and IQ, and what might mediate these associations. Ambivalent/resistant children might be expected to show lower cognitive performance due to their tendency to show more inhibited exploration of the environment (Cassidy, 1986; Hazen & Durrett, 1982). Alternatively, Moss et al. (2005) have suggested that disorganized children are likely to show the lowest levels of cognitive performance due to difficulties in self-regulation, planning skills, and mother–child communication and coordination. In addition, disorganized children have been found to be less task oriented (Schieche & Spangler, 2005), which could lead to lower cognitive performance.

Few studies have tested for differences in cognitive performance among the insecure groups. While Granot and Mayseless (2001) did not find insecure groups to differ on measures of cognitive performance (after controlling for gender), an earlier analysis of the NICHD Early Child Care sample by O'Connor and McCartney (2007) found that insecure ambivalent and insecure/other attachment predicted lower cognitive performance at first grade. Jacobsen et al. (1994) reported that both disorganized and avoidant children performed more poorly on reasoning tasks, with disorganized children showing the lowest levels of performance. Moss and St-Laurent (2001), in a comparison of secure, avoidant, and controlling children, found controlling children to have the lowest academic performance. Stams et al. (2002) reported that children with disorganized attachments in infancy scored lower on a composite measure of cognitive competence at age seven years. There is thus some inconsistency in prior findings, although disorganized children seem to have the greatest cognitive difficulties. Two studies examined potential mediators of the relationship between insecure attachments and cognitive performance. O'Connor and McCartney (2007) reported ambivalent and insecure/other attachment groups negatively predicted cognitive performance. The relationship between ambivalent attachment and cognitive performance was mediated by communication with adults and children's attention. The association between insecure/other attachment and cognitive performance was mediated by task engagement, maternal stimulation, teacher/child relationships, attention, and communication with adults. In addition, Moss and St-Laurent (2001) and Moss et al. (2005) reported that mother–child interaction quality mediated associations between controlling attachment and cognitive performance.

1. Method

1.1. Participants

In 1991, families were recruited from ten sites for the NICHD SECC project. Mothers and newborns from 1364 families were

recruited and were selected with a conditional random sampling procedure that ensured economic, education, and ethnic diversity (see NICHD Early Child Care Research Network, 1994, for more details of the sample). Data from the first three phases were used for the present study. Phase I followed the 1364 child from birth until age 3, Phase II followed the 1226 children from age 3 to second grade, and Phase III followed the remaining 1077 children from grade 2 to grade 6. The current sample consisted of 1253 children who had participated in at least one of the attachment assessments (48.5% of children were female and 81.4% of children were from White/Caucasian families). Missing data were estimated for those participants who had attachment data for at least one attachment assessment using Bayesian analysis multiple imputation procedures in Mplus. As has been done in other analyses of the NICHD data set (e.g., O'Connor and McCartney, 2007) this was done with the assumption that data were missing at random.

1.2. Procedure

Mothers and children participated in the Strange Situation during laboratory visits when children were 15 months and 36 months old, and trained observers visited the homes and completed the Attachment Q-set when children were 24 months old. All of the proposed mediators were assessed between 54 months and second grade. Maternal teaching was measured by observer ratings of the quality of maternal assistance that were based on mother and child interactions assessed at first grade, and teacher reports of parental encouragement of scholastic activities at second grade. Student–teacher and peer relationships were measured with two teacher questionnaires: children's second grade teachers completed the Student–Teacher Relationship Scale, and first grade teachers rated the child's sociometric status (assessed at different grades so we would have multiple teacher perspectives of the child). To measure the child's cooperation in the classroom, first grade teachers rated children's work habits. Lastly, the child's self-regulation was assessed at 54 months with a questionnaire of inhibitory control filled out by the mothers and at first grade with a standard delay of gratification measure that was scored by trained coders. School grades (reported by teachers) and IQ were assessed at grades 3 and 4.

1.3. Measures

1.3.1. Mother–child attachment at 15 months

Children's attachment security was assessed with the standard Strange Situation. In this procedure, the child and mother were videotaped in a series of three-minute episodes in a strange playroom to create stress for the child (see Ainsworth et al., 1978). Separation and reunion episodes from the Strange Situation were videotaped and rated by trained coders following standard procedures. Based on these behaviors, the child was placed in one of the five classifications: secure, insecure-avoidant, insecure-resistant, disorganized, and unclassifiable. Because our hypotheses focused on security rather than the insecure patterns, we coded classifications as secure or insecure. The secure/insecure agreement was 86% ($\kappa = .70$; The NICHD Early Child Care Research Network, 1997). Unclassifiable children were included in the insecure group for the current study.

1.3.2. Mother–child attachment at 24 months

Children's attachment security at 24 months was assessed with the Attachment Q-set (see Waters & Deane, 1985). A trained observer visited the home and observed the mother and child's normal routine while making note of the child's behavior in their natural home setting as well as in response to a semi-structured situation created by the trained observer. These semi-structured

situations included a small book with surprise windows, a snack, and a hide-and-seek game during the last half an hour of the home visit. The observer then completed the Attachment Q-set, which consists of 90 cards, each depicting behavioral characteristics of children. The observer sorted the items into nine piles, from “most characteristic of the child” to “least characteristic of the child”. The placement of the cards in the sort determines the child's score for an item, with the resulting profile then correlated with the profile of a secure child to derive a security score. The inter-rater reliability for the Attachment Q-set was .73 (McCartney, Owen, Booth, Clarke-Stewart, & Vandell, 2004).

1.3.3. Mother–child attachment at 36-months

Children's attachment security at 36 months was assessed with a modified version of the Strange Situation recommended by the MacArthur Working Group on Attachment (Cassidy, Marvin, & the MacArthur Working Group on Attachment, 1992). This modified version did not include a stranger, and the second separation was lengthened to 5 min. Children were rated on a security scale from 1 (very insecure) to 9 (very secure). Across paired coders, the average observer agreement was $r = .73$ (McCartney et al., 2004). The current study utilized the security rating, rather than the categorizations, to maximize variability in the scoring of security. The same coders analyzed the Strange Situation measure at 15 and 36 months.

Although there was no significant association between attachment security at 15 and 24 months, $r = .04$, *ns*, there were small but significant associations between attachment security at 15 and 36 months, $r = .09$, $p < .01$, and attachment security at 24 months and 36 months $r = .17$, $p < .001$. Given the modest overlap in the assessments, we did not combine the three attachment assessments but analyzed them separately.

1.3.4. Quality of assistance

The quality of assistance provided to the child by the mother was assessed using The Mother–Child Interaction Task (Egeland & Heister, 1993) that was completed when the child was in first grade. The first task consisted of the mother and child working together and completing the difficult task of drawing a picture of a house and a tree using an Etch-A-Sketch. In the second activity, the child had to use different shaped pattern blocks to fill in three geometric cutouts for the appropriate blocks. In the third activity, the child and the mother played a replica card game of “slap-jack” called “one-up/one-down”. The mother and child laid cards face up on the pile of existing cards and then raced to slap and claim the growing pile of cards (the new cards placed on the pile had to be either one-level higher or one-level lower than the existing card on the deck). This game was added to measure the child's emotional regulation with the mother in an exciting or frustrating environment and also to observe the child and mother expressions of affect. The quality of parental assistance during the interaction was rated on a 1 (very low) to 7 (very high) scale. The inter-rater reliability (intraclass correlation) for the quality of assistance variable was .87.

1.3.5. Parent encouragement of school

At second grade, the teachers completed the Parent–Teacher Involvement Questionnaire (Conduct Problems Prevention Research Group, 1991). The scale of parent's encouragement of academics was utilized for this study. The scale included nine items that were rated on a scale from 0 (Not at all) to 4 (A Great Deal). Sample items included “How much do you feel this parent has the same goals for his/her child that the school does?”, “To the best of your knowledge, how much does this parent do things to encourage this child's positive attitude toward education?”, and “How important is education in this family?” The internal consistency of that measure in this study (Cronbach's alpha) was .92.

1.3.6. Student–teacher relationship scale

At second grade, the teacher was asked to rate his/her perceived relationship with the child. The Student–Teacher Relationship Scale (STRS; Pianta, 1992) is a 15-item scale that is designed to measure the teachers' perceptions of the quality of the relationship with the student. Teachers completed the Closeness and Conflict scales, rating each item on a 1 (definitely does not apply) to 5 (definitely applies) scale. The scale included items such as “the child openly shares feeling/experiences” (Closeness), and “the child and I always seem to be struggling” (Conflict). Alphas for the conflict and closeness measures were .88 and .92, respectively. The two scales were not combined as they showed only a modest association with each other, $r = -.33$.

1.3.7. Sociometric status

First grade teachers were asked to rate how much the child was liked and disliked by peers on a 5-point scale (1 = popular, 2 = rejected, 3 = neglected, 4 = controversial, 5 = average; see Cillessen, Terry, Coie, & Lochman, 1992). Because of the large correlation between the two indicators, “liked by peers” and “disliked by peers,” ($r = -.57, p < .01$), the “disliked” variable was reverse-scored and the two variables were aggregated to form a single measure of social standing.

1.3.8. School cooperation

To evaluate the child's ability to cooperate with rules and regulations in the school environment, two variables, Work Habits from the Mock Report Card and the Cooperation scale from the Social Skills Rating System (Gresham, Elliott, & Evans-Fernandez, 1993), were utilized. To assess work habits at the first grade level, teachers rated the child's performance on six items, such as “Follows classroom procedures,” “Completes work promptly,” and “Keeps materials organized.” The average of all six items was used to categorize the child's work habits on a 1 (Very Poor) to 5 (Very Good) scale. Cronbach's alpha for this scale was high at .93. A second measure, the Cooperation Scale, was taken from the Social Skills Rating System (SSRS) which teachers completed at first grade. Teachers indicated how often the behavior occurred from 0 (never) to 3 (very often) and how important the behavior was for success in the classroom from 0 (not important) to 2 (critical). The cooperation scale included 10 items from the SSRS concerning behavioral items such as “attends to your instructions” and “puts work materials or school property away” and ranged in scores from zero to 20. The 10 items had high internal reliability yielding a Cronbach's alpha value of .90. Because of the high correlation between Work Habits and the Cooperation Scale ($r = .84, p < .01$), the two were aggregated to form a single measure of cooperation at school.

1.3.9. Children's inhibitory control

To assess the child's level of inhibitory control, the Children's Behavior Questionnaire (Rothbart, Ahadi, & Hershey, 1994) at 54 months was completed by mothers. The present study utilized the Inhibitory Control Scale which was the average of 10 items. Examples of these items include “Has a hard time following instructions,” “Has trouble sitting still when s/he is told to,” and “Can easily stop an activity when s/he is told “no.”” Mothers rated items on a 7-point scale ranging from 1 (extremely untrue) to 7 (extremely true) to reflect the child's reactions during the past six months. The items had high internal reliability and yielded a Cronbach's alpha value of .75.

1.3.10. Delay of gratification

The child's ability to delay gratification was assessed during first grade by using Mischel's (1974, 1981) self-imposed waiting task. The experimenter identified whether the child liked M&Ms, animal crackers, or pretzels the best. The child's preferred food was placed

on two plates in the lab room: one plate with a larger amount and the other a small amount of the preferred food. Then, the child was offered a choice between (a) waiting 7 min until the experimenter returned to the lab room at which time the child could eat a larger quantity of the preferred food, or (b) ringing a bell to bring the experimenter back to the room in fewer than 7 min and being allowed to eat the smaller amount of food. Videotapes were coded by trained personnel to determine the amount of time the child spent attending to the food reward (e.g., looking at it, touching it, talking about it) and not attending to the food reward (i.e., looking away, talking about other things). For this current study, the time for which the child waited to eat the food (maximum of 7 min) was used to measure the delay of gratification.

1.3.11. Cognitive performance

Children's cognitive performance was assessed in two ways. First, teachers completed the Mock Report Card at grades 3 and 4, rating children's current academic performance in the subject areas of reading, oral language, written language, math, social studies, and science. Academic performance for each subject was rated on a scale from 1 (Very Poor) to 5 (Very Good). A computed mean of all six subjects was used to categorize the child's performance (alphas at both grades were .95). Because of the high correlation between the two mock report cards from third and fourth grade ($r = .73, p < .01$), the two measures were aggregated to form a single measure of academic performance in middle childhood.

Second, the child's IQ was assessed with four of the Cognitive Skills subscales (memory for names, sentences, picture vocabulary, and verbal analogies) from the Woodcock–Johnson Psycho-Educational Battery-Revised (WJ-R; Woodcock & Johnson, 1989) at third grade. Standard scores for these scales were aggregated to derive a single composite of cognitive ability. Although nine subscales from the WJ-R were administered at third grade, only four of the subtests assessed cognitive skills, whereas the other five assessed achievement, and therefore, the four subtests of cognitive ability were utilized for the current study. The Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999) was administered in fourth grade. The WASI is an estimate of cognitive abilities that includes testing verbal knowledge, nonverbal and verbal reasoning, and visual information processing. Because of the high correlation between the scores from the WJ-R and the WASI ($r = .73, p < .01$), the two were aggregated to form a single measure of IQ.

2. Results

First, the correlations between the demographic variables (children's gender and ethnicity, as well as their family's income to needs ratio) and attachment variables, cognitive performance variables, and potential mediators were examined to determine whether subsequent analyses should control for the demographic variables. Next, we examined the relation between attachment security and cognitive performance (academic performance and IQ). Then, correlations between attachment security at 15, 24, and 36 months and the proposed mediators were examined. As a next step, we examined whether the proposed mediators significantly explained associations between attachment and cognitive performance. We did so by conducting a series of path analyses in Mplus to evaluate multiple mediation. Finally, we also examined correlations and conducted mediation analyses for the three insecure attachment patterns assessed at 15 and 36 months.

Although preliminary analyses indicated that the demographic variables were not related to attachment security at 15 months, all demographic variables were related to attachment security at 24 and 36 months. Gender, ethnicity (white and non-white), and income were also related to the mediators and measures of

Table 2

Correlations of 15, 24, and 36-month secure attachment with cognitive performance and potential mediators in middle childhood (with partial correlations controlling for demographic variables).

	Attachment: 15 months	Attachment: 24 months	Attachment: 36 months
Cognitive performance			
Academic performance	.01 (–.01)	.22* (.13*)	.18* (.15*)
IQ	.02 (–.04)	.23* (.16*)	.21* (.16*)
Attachment-teaching			
Maternal quality of assistance	.06 (.01)	.18* (.13*)	.22* (.15*)
Encouragement of school	.05 (.01)	.22* (.18*)	.14* (.11*)
Social-network hypothesis			
Student–teacher closeness	.04 (.01)	.09* (.02)	.14* (.11*)
Student–teacher conflict	.01 (.04)	–.21* (–.15*)	–.10* (–.08)
Likability by peers	.07* (.08*)	.11* (.05)	.09* (.08*)
Attachment-cooperation			
School cooperation	.03 (.03)	.16* (.05)	.13* (.13*)
Self-regulation			
Child's inhibitory control	.02 (–.03)	.22* (.16*)	.09* (.05)
Delay of gratification	.04 (–.02)	.14* (.10*)	.11* (.11*)

Note: Partial indicates correlations controlling for demographic variables including child gender, child ethnicity, and family income.

* $p < .05$.

cognitive performance, except that gender was not related to parental encouragement of academics, delay of gratification, or IQ. Because there were so many associations between demographic variables and the main study variables, we controlled for gender, ethnicity, and family income in our main analyses. After controlling for the demographic variables, the correlation between academic performance and IQ dropped, from $r = .69$ to $r = .58$, $p < .001$. All of the subsequent analyses were performed separately for academic performance and IQ to examine whether the two were related in similar ways to attachment and the proposed mediators.

2.1. Attachment security and cognitive performance

To address the first research question of whether attachment is related to cognitive performance, we examined the correlations between these variables (see Table 2). Analyses showed that both academic performance and IQ were related to attachment at 24 and 36 months, but were not related to attachment at 15 months. Specifically, children who were more securely attached at 24 or 36 months showed higher academic performance and had higher IQ scores in middle childhood. The magnitude of the associations with attachment was similar for academic performance and IQ. These findings were still significant after controlling for demographic variables.

2.2. Attachment security and the proposed mediators

Table 3 shows the correlations among the eight mediator variables. As can be seen in the table, for the most part, associations among the variables were modest in magnitude. For example, only one of the partial correlations (controlling for demographic factors) exceeded .50, five correlations were between .30 and .40, and the remaining 22 correlations were all less than .30. These results suggest the mediator variables captured distinct constructs.

To address the second research question, whether attachment was related to the proposed mediators, we examined the correlations between these variables (see Table 2). Attachment at 15 months was not related to any of the mediator variables, except peer acceptance. By contrast, and consistent with our hypotheses, attachment at 24 and 36 months was significantly related to all of the proposed mediators. Children who were more securely attached at 24 and 36 months had parents who provided higher quality maternal assistance and more encouragement of school, formed better social relationships with teachers and

peers, were more cooperative in the school environment, and showed better self-regulation. When controlling for the demographic variables, student–teacher closeness, likability by peers, and school cooperation were no longer significantly correlated with 24-month attachment, and student–teacher conflict and the child's inhibitory control were no longer significantly related to 36-month attachment, suggesting that demographic characteristics may have influenced both attachment and child characteristics and inflated their degree of association.

2.3. Cognitive performance and the proposed mediators

Both academic performance and IQ were significantly correlated with all proposed mediators (see Table 4). That is, children who received higher quality teaching from mothers and more encouragement of scholastic-related activities, had better relationships with teachers and peers, were more cooperative at school, and showed better self-control performed better academically and had higher IQ scores. These findings did not change when controlling for demographic variables, except that teacher–child closeness was no longer significantly related to IQ.

2.4. Tests of mediation of attachment security

The next sets of analyses were performed to test our mediation hypotheses. To address our primary research questions we conducted four path analyses to test whether the proposed mediators significantly accounted for the relations between attachment (at 24 or 36 months) and cognitive performance (academic performance or IQ). We controlled for the effects of the three demographic variables (gender, ethnicity, family income) in all path analyses by specifying them as predictors of the cognitive performance measure. We evaluated our mediators (indirect effects) as a set, using multiple mediation in Mplus analysis, which allowed us to evaluate which of our mediators were uniquely mediating associations between attachment and cognitive performance (Little, Preacher, Selig, & Card, 2007). The results of the multiple mediation analyses from age 24 and 36 months are displayed in Table 5, in which we note the significant indirect paths.

2.4.1. Attachment security and academic performance

Several variables were unique mediators of the relationship between 24-month attachment security and academic performance in middle childhood (i.e., controlling for all other variables).

Table 3
Intercorrelations between mediator variables.

Measure	1	2	3	4	5	6	7	8
1. Maternal quality of assistance	–	.21**	.06	–.15**	.12**	.10*	.14**	.13**
2. Parent encouragement of school	.33**	–	.34**	–.35**	.24**	.33**	.12**	.16**
3. Closeness with teacher	.11**	.37**	–	–.29**	.16**	.13**	.04	–.01
4. Conflict with teacher	–.21**	–.39**	–.33**	–	–.38**	–.40**	–.22**	–.13**
5. Likability by peers	.17**	.29**	.21**	–.38**	–	.54**	.16**	.13**
6. School cooperation	.19**	.36**	.21**	–.41**	.55**	–	.20**	.21**
7. Inhibitory Control	.17**	.19**	.11**	–.24**	.19**	.27**	–	.14**
8. Delay of gratification	.25**	.26**	.06	–.18**	.18**	.26**	.18**	–

Note: Values below diagonal are bivariate correlations and above diagonal are partial correlations, controlling for gender, ethnicity, and income to needs ratio.

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

Table 4
Correlations of potential mediators with cognitive performance in middle childhood (with partial correlations controlling for demographic variables).

Potential mediators	Academic performance	IQ
Attachment-teaching		
Quality of assistance	.34* (.17*)	.42* (.22*)
Encouragement of academics	.43* (.38')	.33* (.21')
Social-network		
Student-teacher closeness	.19* (.11')	.14* (.07)
Student-teacher conflict	–.29* (–.26')	–.24* (–.12')
Likability by peers	.28* (.23')	.16* (.11')
Attachment-cooperation		
School cooperation	.54* (.49')	.35* (.27')
Self-regulation		
Child's inhibitory control	.24* (.18')	.20* (.14')
Delay of gratification	.30* (.22')	.33* (.22')

Note: Partial indicates correlations significance controlling for demographic variables including child gender, child ethnicity, and family income.
* $p < .05$.

The attachment-teaching hypothesis was supported in that maternal quality of assistance and parental encouragement of school each uniquely explained in part the association between 24-month attachment and academic performance. The social network hypothesis was partially supported as likability by peers, but not conflict or closeness with the teacher, was a unique mediator. The attachment-cooperation hypothesis was supported, as school

cooperation uniquely mediated the association between 24-month attachment and academic performance. Lastly, the self-regulation hypothesis was partially supported by the finding that delay of gratification, but not inhibitory control, was a unique mediator. The path from 24-month attachment security to academic performance remained significant ($p < .05$) even when all mediators were included in the model.

Table 5
Results of multiple mediation analyses for secure attachment.

	Indirect path estimates	
	Academic performance	IQ
24-Month attachment		
1. Maternal quality of assistance	.02**	.04**
2. Parent encouragement of school	.04**	.01
3. Closeness with teacher	.00	.00
4. Conflict with teacher	–.01	–.00
5. Likability by peers	–.01*	–.01*
6. School cooperation	.08**	.04**
7. Inhibitory control	.01	.01
8. Delay of gratification	.01*	.02**
36-Month attachment		
1. Maternal quality of assistance	.02**	.05**
2. Parent encouragement of school	.03**	.01
3. Closeness with teacher	.00	.00
4. Conflict with teacher	.00	.00
5. Likability by peers	–.01*	–.01*
6. School cooperation	.06**	.03**
7. Inhibitory control	.01	.00
8. Delay of gratification	.01*	.02**

Note: Indirect path estimates for the unique contribution of each mediator to the relationship between secure mother-child attachment at 24 or 36-months and cognitive performance at grades 3 and 4 are reported.

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

Similar results were found for the relationship between 36-month attachment and academic performance in middle childhood. Maternal quality of assistance, parental encouragement of school, likability by peers, school cooperation, and delay of gratification each uniquely explained in part the relationship between 36-month attachment and academic performance, lending support to each of the four hypotheses. The path from 36-month attachment to academic performance was marginally significant ($p = .05$) when all mediators were included in the model.

2.4.2. Attachment security and IQ

There were also several variables that uniquely accounted for part of the association between 24-month attachment and middle childhood IQ. The attachment-teaching hypothesis was supported in that maternal quality of assistance, but not parental encouragement of schooling, mediated the relationship between 24-month attachment and IQ. The social network hypothesis was supported, as likability by peers, but not teacher-child relationship quality, mediated the relationship between attachment and IQ. The attachment-cooperation hypothesis was also supported, as school cooperation mediated the relationship between 24-month attachment and IQ. Lastly, the self-regulation hypothesis was supported by the finding that delay of gratification, but not inhibitory control, was a unique mediator. The path from 24-month attachment to IQ remained significant ($p = .001$) when all mediating variables were included in the model.

Similar results were found for the relationship between 36-month attachment and IQ. Maternal quality of assistance, likability by peers, school cooperation, and delay of gratification uniquely explained in part the relationship between 36-month attachment and IQ, further lending support to each of the four hypotheses explaining the association between attachment and cognitive performance. The path from 36-month attachment to IQ also remained significant ($p = .002$) when all of the mediators were included in the model.

2.5. Insecure attachment patterns: associations with academic performance, IQ, and mediators

To address our secondary goal, we first examined whether avoidant, ambivalent, and disorganized attachment, assessed at 15 and 36 months, were directly related to academic performance or IQ. Insecure attachment patterns at 15 months, and avoidant attachment at 36 months, were not related to academic performance or IQ in middle childhood. Children who were ambivalent at 36 months had lower grades ($r = -.09$, controlling for demographics, $r = -.08$, $ps < .05$) and IQ scores ($r = -.11$, partial $r = -.09$, $ps < .05$) in middle childhood. Children who were disorganized at 36 months also had lower grades ($r = -.08$ and partial $r = -.07$, $ps < .05$) and lower IQ scores ($r = -.11$ and partial $r = -.09$, $ps < .05$) in middle childhood.

2.5.1. Tests of mediation of insecure attachment patterns

To examine mediation for the insecure patterns, we conducted analyses that were analogous to the ones we conducted to examine mediation pathways between secure attachment and cognitive performance. Mediation tests were conducted for those insecure patterns that were related to our measures of cognitive performance. Thus, we conducted four path analyses to test whether the proposed mediators significantly accounted for the relations between ambivalent or disorganized attachment at 36 months and later cognitive performance (academic performance or IQ). As in the analyses for attachment security, we controlled for the effects of gender, ethnicity, and family income in all path analyses by specifying them as predictors of the cognitive performance measure, and we evaluated our mediators (indirect effects) as a set, using

multiple mediation. In the interest of space, we present these findings briefly (reporting significant indirect tests in the text; full analyses are available from the authors).

2.5.2. Insecure attachment patterns and academic performance

We found significant mediation effects for both ambivalent and disorganized attachment. Specifically, tests of mediation for 36 month attachment showed that low parent encouragement of schooling ($-.02$) and low school cooperation ($-.03$) partially explained associations between ambivalent attachment and academic performance, $ps < .05$, and the direct path from 36-month ambivalent attachment to grades was no longer significant when all of the mediators were included in the model. Low quality maternal assistance ($-.02$) and low school cooperation ($-.04$) partially explained associations between disorganized attachment and academic performance, $ps < .05$, and the direct path from 36-month disorganized attachment to grades was no longer significant when all of the mediators were included in the model.

2.5.3. Insecure attachment patterns and IQ

There were no significant mediators between ambivalent attachment at 36 months and later IQ, but there were three unique mediators for disorganized attachment and IQ. Greater likability by peers (.01), low quality of assistance from mothers ($-.04$), and low school cooperation ($-.02$) all partially explained associations between disorganized attachment and IQ, $ps < .05$, and the direct path from 36-month disorganized attachment to IQ was no longer significant when all of the mediators were included in the model.

3. Discussion

This study advances our understanding of how and why early attachment security is related to children's cognitive performance during the elementary school years. The first question was whether mother-child attachment was related to children's cognitive performance in middle childhood, specifically academic performance and IQ. We included both indices of cognitive performance to understand if there is specificity in how attachment security predicts a child's later cognitive outcomes. We found that secure attachment at 24 or 36 months, but not secure attachment as assessed at 15 months, was related to better academic performance and higher IQ in middle childhood, and the magnitude of the associations was similar for the two different measures of cognitive performance. Given these associations, we explored four mediation hypotheses that could explain why children who were more securely attached at 24 or 36 months showed better cognitive performance. We found some support for all of our hypotheses. Specifically, we found that maternal teaching qualities and encouragement of academics, relationships with peers, cooperation in school, and delay of gratification all uniquely mediated associations between attachment at 24 or 36 months and later academic performance. Results were similar for attachment and IQ, except that parent encouragement of schooling was not a significant mediator of later IQ. All of these findings were significant after controlling for demographic variables. Despite the modest association between the 24 and 36 month attachment assessments, the two attachment measures showed a similar pattern of associations with the mediators and indices of cognitive performance and similar mediation pathways. Insecure attachment patterns at 15 months, and avoidant attachment at 36 months, were not related to academic performance or IQ in middle childhood. Children who were ambivalent or disorganized at 36 months had lower grades and IQ scores in middle childhood, and these effects were primarily mediated by parenting and child cooperation.

3.1. Attachment and cognitive performance

Previous tests of the developmental significance of attachment have focused more on the child's social development (e.g., peer relationships) than on cognitive development, although in early childhood attachment has been shown to be related to cognitive performance (De Ruiter and van IJzendoorn, 1993; van IJzendoorn et al., 1995). As shown in Table 1, there is some evidence that securely attached children perform better in school during middle childhood, although findings regarding associations between attachment security and IQ in middle childhood have been mixed. One difficulty in reconciling earlier findings is that academic performance and IQ were not examined in the same study, and therefore sample differences might account for the discrepant results. In addition, small sample sizes often precluded the identification of small effects. The present study extended earlier findings by showing – in a large sample followed longitudinally – that attachment security at toddler and preschool age, but not infant attachment, predict both academic performance and IQ in middle childhood. In this study, there was only modest continuity between attachment at 15 and 36 months, and no association between attachment at 15 and 24 months. The present findings suggest that infant attachment (assessed at 15 months) may not have a lasting impact on cognitive development in the absence of continuity in attachment quality. Although 15 month attachment appears to have been reliably assessed in the NICHD study, the low attachment stability in this sample may explain why it is only attachment at 24 and 36 months that predict cognitive performance in middle childhood. Effect sizes for relations between toddler and preschool attachment and cognitive performance were modest in magnitude, which might be expected given the extended time frame (five to seven years) and the fact that attachment security is only one of many influences on children's cognitive development. Small differences are, nevertheless, important, because their effects can accumulate over time.

Although there is a strong theoretical basis for expecting attachment to be related to social and personality development, there have been questions raised regarding whether attachment security would be related to cognitive performance (Sroufe, 1988), and if so, what might explain these relations (Sroufe, 1988; van IJzendoorn et al., 1995). Our findings suggest attachment may have implications for children's cognitive performance during middle childhood, suggesting there is a need for further studies to examine how attachment is related to different indices of cognitive competence. It is possible that the cognitive benefits from secure attachment are small but accrue over time such that effects are stronger at older ages. To date, studies of attachment and cognitive development are limited in that they use non-experimental designs. A burgeoning area of research in attachment has examined parenting interventions that are designed to enhance attachment security (Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003), and these interventions have also been shown to reduce children's behavior problems (Moss et al., 2011). Experimental intervention studies could be expanded to include cognitive development indices as outcome measures, which would provide a stronger test of the hypothesis that secure attachment is associated with enhanced cognitive performance.

3.2. Explaining associations between attachment and cognitive performance

An additional important question is what explains the obtained associations between secure attachment and cognitive performance. Our study also focused on understanding what might be some of the social experiences and child characteristics that

account for this association. We tested four hypotheses proposed by van IJzendoorn et al. (1995).

The *attachment-teaching hypothesis* focuses on the ability of parents of securely attached children to be better “informal” teachers. Consistent with the attachment-teaching hypothesis, and other studies (Moss & St-Laurent, 2001; O'Connor & McCartney, 2007), we found that the mothers' quality of maternal assistance explained why securely attached children performed better both academically and on IQ tests. Parents of more securely attached children may be better teachers due to the already established relationship that they have with their child. This positive, secure relationship may potentially allow the child to find it easier to learn from and engage with someone whom they trust due to the consistent responsiveness they receive from parents. Parents of securely attached children may also be more likely to use a teaching method called scaffolding, in which a parent sensitively provides a child with help only when needed (van de Pol, Volman, & Beishvizen, 2010), which may foster a child's cognitive development. A novel finding of this study was that a mother's encouragement of academics also explained higher academic performance of more securely attached children. As noted by Grusec, Goodnow, and Kuczynski (2000), there has been little research on how attachment is related to parenting attitudes and values. Our study suggests that mothers of more securely attached children may influence children's cognitive development through the attitudes they convey about the importance of engaging in academic activities.

The *social-network hypothesis* focuses on how relationships with teachers and peers contribute to better cognitive performance. More positive relationships with teachers and peers may promote greater comfort with the school environment and lead to greater cognitive stimulation (Kerns, 2008; van IJzendoorn et al., 1995). In this study, more securely attached children later formed closer and less conflictual relationships with teachers, and in turn teacher-child relationship quality was related to later academic performance and IQ. However, unlike O'Connor and McCartney (2007), we did not find that teacher-child relationship quality was a unique mediator of associations between attachment and cognitive performance. Instead, we found that peer relationships mediated associations of attachment with academic performance and IQ. Positive peer relationships increase academic motivation in a school context (Ladd, Birch, & Buhs, 1999; Ladd & Coleman, 1997; Shin, 2007), and as peer relationships become increasingly important across childhood they may have a greater impact on cognitive performance.

The *attachment-cooperation hypothesis* focuses on how secure mother-child attachment encourages cooperative skills that can facilitate a child's learning. Results of the current study provide evidence that securely attached children achieve higher academic performance due to their ease of following classroom procedures. One possibility is that securely attached children are less worried (Muris, Meesters, Merckelbach, & Hulsenbeck, 2000) and their attachment-system is activated less often (van IJzendoorn et al., 1995), which allows for better concentration and attention to classroom procedures and instructions. In addition, it may be that securely attached children are more compliant in testing situations, as well as with testers (O'Connor & McCartney, 2007; van IJzendoorn et al., 1995), which could facilitate performance on both classroom assignments and IQ tests.

According to the *self-regulation hypothesis*, securely attached children may perform better cognitively due to their own self-motivation and self-control. The ability to show self-regulation may allow a child to be more reflective in the learning environment, which can ultimately lead to better cognitive performance. In the present study, both inhibitory control and delay of gratification were related to both attachment and academic performance, although only delay of gratification mediated the positive

relationships of attachment with cognitive performance. Attentive skills, fostered by a secure mother–child relationship (i.e., Granot & Maysseles, 2001; Jacobsen & Hofmann, 1997; Moss & St-Laurent, 2001; O'Connor & McCartney, 2007) may allow the child to be less tempted by other distractions and to stay on task, which may explain the positive relationship between attachment and cognitive performance.

Although we found support for all four of the hypotheses we studied, it is important to note that as a group the mediators did not fully account for associations between attachment and cognitive performance. That is, our path analyses revealed that attachment security was still a significant predictor of cognitive performance, even after controlling for our set of mediators. One possibility is that the availability of a secure base directly affects cognitive development. By using their primary caregiver as a secure base, securely attached children may feel more at ease when exploring (Ainsworth et al., 1978; Bowlby, 1969, 1980), which could prepare the child to benefit from instruction in a classroom setting. Another possibility is that there are other potential mediators that could be investigated. For example, this study did not consider children's beliefs (e.g., attributions for performance), internal states (e.g., anxiety), or self-motivational factors (e.g., attitudes toward schooling). Future studies are needed to explore these other potential mechanisms.

A secondary goal of the present study was to investigate whether different insecure attachment patterns (avoidant, ambivalent, and disorganized) are related to cognitive performance. We found that ambivalent attachment at 36 months predicted lower grades and IQ scores in middle childhood. Although we did not find any significant mediators between ambivalent attachment and IQ, low encouragement of school and low school cooperation mediated the negative relationship between ambivalent attachment and grades. Other studies (e.g., Hazen & Durrett, 1982) suggest ambivalent children may show lower indices of cognitive performance due to their lack of exploration. O'Connor and McCartney (2007) also found ambivalent attachment to be related to attention problems. It is possible that children with ambivalent attachments may show lower cognitive performance due to the stress of being away from their secure base, which can inhibit their exploration and lead the child to be less cooperative and less attentive in a classroom setting. In addition, our findings suggest that mothers of ambivalent children may also play a role, in that they are less likely to encourage the child's involvement in schooling.

Disorganized attachment at 36 months also predicted lower grades and IQ scores in middle childhood, and these associations were most consistently mediated by quality of maternal assistance and child cooperation. Our findings for quality of assistance are consistent with Moss et al.'s (2005) suggestion that difficulties in mother–child communication and coordination may explain the lower cognitive performance of disorganized children. Moss et al. (2005) and Schieche and Spangler (2005) suggested that disorganized children may have difficulties in self-regulating behaviors. Our study suggests disorganized children may have difficulty cooperating in the school context, which could interfere with children's attention and learning.

This study contributes to the literature on attachment and cognitive development by identifying several factors that might explain or mediate the relations between early mother–child attachment and cognitive performance in middle childhood. We found evidence for several mediators, although it is also important to note that any one mediator only accounted for a small amount of the variance in cognitive development. This is not surprising, given the multiple potential influences on cognitive development. Cicchetti and Rogosch (1996) discussed the concept of equifinality, which refers to the idea that many different predictors may lead to the same result. It is likely that each individual mediator partially contributes to the association between mother–child attachment

and cognitive performance, and that any one mediator is therefore unlikely to be the most important for explaining the association for all children.

3.3. Limitations and future directions

The findings from the present study provide evidence of a link between mother–child attachment security and cognitive performance. Although this study provides valuable information, in that all of the proposed mediation hypotheses received some support, this work could be extended to address study limitations. One limitation is the sample; although large, the NICHD sample is not nationally representative and undersampled minority and low income families. A second limitation is that our measure of peer acceptance came from teachers rather than peers, who may be more accurate reporters of peer liking. Future research could extend the present study by examining whether mother–child attachment is also predictive of later cognitive outcomes in adolescence, which is a time when other mediators (e.g., self-motivation) may be important. Finally, although our models yielded support, it is also important to consider other possible models. For example, future research could focus on how early attachment might affect the development of early cognitive skills (e.g., language acquisition), which in turn might contribute to later academic performance or IQ.

In conclusion, the present study builds on earlier work (Duchesne & Larose, 2007; Moss & St-Laurent, 2001; O'Connor & McCartney, 2007) in testing mechanisms that may explain why securely attached children show enhanced cognitive performance. Identification of mechanisms is important because it can facilitate intervention efforts to enhance children's cognitive development. We used a diverse set of measures, drawing on different data sources, to study several specific mechanisms that had not yet been explored. The present study suggests that parenting, peer relationships, child cooperation, and child self-regulation help to explain why the formation of a secure attachment can place children on a pathway toward better cognitive performance in middle childhood. The findings thus underscore that diverse experiences in multiple contexts (home and school), and a consideration of both relationships with adults and child characteristics, are important to consider in models of academic performance and IQ.

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