



Relations among peer acceptance, inhibitory control, and math achievement in early adolescence

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ABSTRACT

This study examined relations among peer acceptance, inhibitory control, and math achievement in ninety-nine 4th and 5th grade early adolescents. Teachers rated students on peer acceptance and students completed a computerized executive function task assessing inhibitory control. Math achievement was assessed via end of year math grades. Results indicated that both inhibitory control and peer acceptance were positively and significantly related to math achievement. In addition, peer acceptance significantly mediated the relationship between inhibitory control and math grades when all three variables were entered simultaneously in a linear regression model. These results suggest that peer acceptance is an important indicator of social functioning and plays a significant part in academic success in the classroom. Results also suggest that indicators of social functioning – such as peer acceptance – need to be included in addition to cognitive functioning, when examining academic achievement in early adolescence.

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Positive peer relationships become increasingly important in young people's overall development and well-being during early adolescence (Oberle, Schonert-Reichl, & Thomson, 2010; Rubin, Bukowski, & Parker, 2006). Decades of research seem to suggest that peer acceptance – the degree to which a child is socially accepted and liked by his or her peers – emerges as a core indicator for social and emotional well-being and academic success during the early adolescent years (Nangle & Erdley, 2001; Oberle et al., 2010; Wentzel, 2003, 2005, 2009). Particularly, studies on peer acceptance during the middle school years indicate that early adolescents who are popular, accepted, and have positive relationships with their peers also tend to be socially well-adjusted, and academically more successful than those who are rejected by their peers (e.g., Bierman, 2004; Furrer & Skinner, 2003; Véronneau & Vitaro, 2007; Wentzel, 1991; Wentzel & Caldwell, 1997). Explanations for the critical role of peer acceptance in academic achievement have centered around the notion that belonging to a friendship group in school can increase motivation to engage in classroom and school activities, and be a valuable source of social support for students in the school context, particularly during early adolescence (Véronneau, Vitaro, Brendgen, Dishion, & Tremblay, 2010; Wentzel, 2003).

One contributor to peer acceptance is inhibitory control, an executive function which is related to the ability to regulate one's own emotions and behavior, thus being a core ability needed to function socially and to form and maintain positive social relationships (Eisenberg, Fabes,

Guthrie, & Reiser, 2000; Hughes, White, Sharpen, & Dunn, 2000). Inhibitory control is an executive control process that contributes to organizing, sequencing, and regulating behavior in adults as well as children and adolescents (Best & Miller, 2010; Reimers & Maylor, 2005). Together with the other executive control processes – working memory and cognitive flexibility – inhibitory control skills play a crucial role in everyday activities and functioning such as planning, holding, and managing multiple goals, and maintaining cognitive flexibility (Davidson, Amso, Cruess Anderson, & Diamond, 2006; Zelazo & Müller, 2002). Inhibitory control as an indicator of social and emotional functioning plays a significant role in both academic achievement and overall functioning and adjustment in social settings such as school (Bierman, Nix, Greenberg, Clair, & Domitrovich, 2008; Greenberg, 2006; Rhoades, Greenberg, & Domitrovich, 2009). The research conducted by both Bierman et al. (2008) and Rhoades et al. (2009), however, focused exclusively on 3- to 5-year-old children in preschool settings from low-income families. Hence, the findings from these studies indicating positive relationships among inhibitory control, social adjustment, and positive academic growth have limited generalizability beyond the developmental period of early childhood, and may be specific to young children from low-income families attending a Head Start preschool program.

Much of the research investigating the interplay of cognitive, social, and academic development has focused either on peer relationships in relation to academic achievement (e.g., Véronneau & Vitaro, 2007; Wentzel, 2003; Wentzel & Caldwell, 1997) or on inhibitory control in relation to academic achievement (e.g., Blair & Razza, 2007; Espy et al., 2004), and studies that bring these three constructs together in one investigation are relatively rare. To our knowledge only one study

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has examined relations among inhibitory control, peer acceptance, and academic achievement simultaneously in a sample of pre- and early adolescents (see Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). Accordingly, the aim of this investigation was to further elucidate the ways that cognitive and social factors influence academic achievement by examining relations among peer acceptance, inhibitory control, and math achievement in early adolescence. Merging these fields of research is important for two reasons. First, both successful peer relationships and inhibitory control skills have in common the underlying ability to self-regulate (e.g., Blair & Diamond, 2008; Davidson et al., 2006; Olsen, Lopez-Duncan, Lunkenheimer, Chang, & Sameroff, 2003; Patrick, 1997; Valiente et al., 2008). Second, both peer relationships and inhibitory control play a crucial role in academic achievement throughout adolescence (Nichols & White, 2001). Valiente et al. (2008) suggest that further research is needed that bridges extant literatures on various indicators of self-regulatory competencies in relation to academic achievement, and simultaneously investigates cognitive indicators alongside social relationships.

Inhibitory control: a predictor of social and academic functioning

Inhibitory control is a core executive function dimension that contributes to the successful formation of peer relationships from an early age (Hay, Payne, & Chadwick, 2004; Hughes et al., 2000). The importance of inhibitory control in peer acceptance and positive peer relationships can be explained by the contention that successful peer relationships require self-regulatory skills such as suppressing inappropriate social responses in a given situation (e.g., telling a secret, invading someone's space, taking away what belongs to someone else, getting aggressive when being disappointed by a friend) (Rotenberg, Michalik, Eisenberg, & Betts, 2008). There is evidence that inhibitory control matters to social adjustment in the school context. For instance, it has been established that greater capacities for inhibitory control are associated with fewer internalizing and externalizing problems, greater sympathy for others, and overall superior social and emotional competence in kindergarten through to 5th grade (Eisenberg et al., 2000; Lengua, 2003). Furthermore, Blair and Razza (2007) found that the inhibitory control aspect of self-regulation was significantly related to math skills in three to five year olds. Similarly, Espy et al. (2004) found that inhibitory control was a significant predictor of math achievement in a sample of preschool students.

Considering both academic and social adjustment at the same time, Rotenberg et al. (2008) found that trustworthiness – a characteristic that is positively related to having friends and being accepted – partially mediated the relationship between inhibitory control and adjustment among 3- to 5-year old children. Last, Valiente et al. (2008) found that teacher–child relationship partially mediated the relation between parent-reported effortful control – a skill related to inhibitory control – and academic achievement in 7- to 12-year-old elementary school students. The Valiente et al. study is important because it reveals the power of social relationships for academic achievement, and suggests that social aspects may partially account for the link between executive skills and academic success.

Current findings are promising but subject to certain limitations. Chief among these is the fact that little research has been done jointly examining relations among inhibitory control, social relationships, and school achievement. We are aware of only one study merging the three fields of research (see Valiente et al., 2008); however, the authors focused on teacher–child relationships in the classroom when investigating the link between executive skills and academic success, and their executive skill of focus was effortful control as reported by students' parents. The study's main findings were that teacher–child relationships, social competence, and classroom participation partially mediated the relation between effortful control and change in academic grades throughout the school year. In addition, they found that teacher–child relationships and classroom participation were also partial mediators for change in school absences across

the year. Because peers become increasingly important for social well-being and academic achievement in early adolescence (Bierman, 2004; Wentzel & Caldwell, 1997), the present study focuses on peer acceptance in relation to inhibitory control and academic achievement, and therefore allows for an examination of the relations among these three important developmental areas.

Peer relationships and positive development in early adolescence

Becoming part of a peer group is an important developmental task to be mastered in adolescence (Newman & Newman, 1976). Positive peer relationships are considered an asset that promotes thriving and successful pathways through life within the theoretical framework of Positive Youth Development (PYD; Lerner, von Eye, Lerner, Levin-Bizan, & Bowers, 2010). Peer acceptance in particular has been identified as a core indicator for multiple domains of success and well-being – including social, emotional, and mental well-being, and academic success (Anderman & Freeman, 2004; Furlong et al., 2003; Haynes, Emmons, & Ben-Avie, 1997; Osterman, 2000; Whitlock, 2006). In fact, researchers have noted that having friends and positive relationships with peers in school contributes to a feeling of belongingness to school, which in itself is a key to academic achievement motivation and success (e.g., Roeser, Midgley, & Urdan, 1996). Young people can benefit in their academic development from being part of a peer group with high achievement motivation and a high level of academic success (Hartup, 1996; Ryan, 2001). A group of high achieving peers reflects an established value of academic achievement and school engagement in the group, which sets a positive norm for group members (Witkow & Fuligni, 2010).

Being accepted in school and having friends has a powerful impact on school experiences and contributes to an overall positive school experience, making school a desirable place to go (Larson, 2000). Witkow and Fuligni (2010), for example, found that having friends in school significantly predicts higher GPA in adolescence, and that this relationship could be explained by having shared academic experience with in-school peers, identifying with the in-school peer group and therefore feeling more connected to aspects of school life in general than those who have predominately out-of-school peers. This finding aligns with previous research suggesting that positive peer relationships in school play a significant role in academic success (e.g., Bierman, 2004; Furrer & Skinner, 2003; Véronneau & Vitaro, 2007; Wentzel, 1991; Wentzel & Caldwell, 1997).

Overall, research has indicated that the social aspect of academic success cannot be ignored. Particularly during early adolescence, when the social focus shifts away from the family and toward the peer group (Larson & Richards, 1991), being accepted and having friends at school emerges as an important aspect for positive growth in school. Peer acceptance and friendships in the school setting contribute to the formation of a positive school identity and therefore need to be considered part of the pathway to academic success (Cooper, Valentine, Nye, & Lindsay, 1999). Overall, the present study addresses a gap in the literature on the social and cognitive foundations of academic success. First, our study is one of the few combining three crucial fields of development, namely cognitive, social, and academic development (see Valiente et al., 2008). Second, we focus on the developmental period of early adolescence in contrast to previous research in this field that has predominately been conducted with younger children (e.g., Bierman et al., 2008). Last, our study investigates the role of peer acceptance in relation to executive control skills and academic achievement. Both theory and research indicate that being accepted by one's peers is a particularly salient and important dimension of social functioning given the strong focus on the peer group during the early adolescent age-period, and therefore needs to be considered when understanding academic outcomes (Eccles & Roeser, 2009).

Summary and hypothesis

Affiliating with a peer group and succeeding academically in the school setting are two important aspects of establishing a positive developmental pathway in early adolescence (Roeser et al., 1996; Witkow & Fuligni, 2010). Those two aspects of early adolescent development are closely connected. Indeed, previous research has identified peer acceptance and having friends in school as a positive predictor of school adjustment and academic success (e.g., Bierman, 2004). In addition, research has indicated that inhibitory control is the main executive skill underlying both successful academic functioning and the ability to form and maintain positive social relationships (Eisenberg et al., 2000; Rotenberg et al., 2008). Inhibitory control is important for social functioning and thus for forming positive peer relationships (Bierman et al., 2008; St. Claire-Thompson & Gathercole, 2006); furthermore, being accepted in school is positively related to academic engagement, motivation, and higher achievement in school (e.g., Furrer & Skinner, 2003). Based on previous theoretical considerations and research findings, we therefore assumed that higher inhibitory control contributes to better social acceptance by peers in the school setting, which in turn has a positive impact on early adolescents' grades. In particular, we predicted that peer acceptance would mediate the relationship between inhibitory control and math grades (Valiente et al., 2008). Specifically, we expected that a cognitive aspect of self-regulation in relation to academic achievement can be explained through social acceptance, and that better self-regulation and executive control skills are positively related to social acceptance, which in turn is a key for academic success in the classroom.

Methods

Participants

Participants were 56 male and 43 female early adolescents in four 4th and 5th grade classrooms in four different public elementary schools located in middle class neighborhoods in a suburb of a large city in Western Canada. Participants were part of a larger study examining the effects of a school-based social and emotional competence promotion program. Inhibitory control and peer acceptance data for the current study were drawn from measures administered prior to the intervention (i.e., pre-test). Math grades were obtained from school records at the end of the year.¹ Forty students were in fourth grade and 59 students were in fifth grade. Students' ages ranged from 9.00 to 11.16 years ($M = 10.23$ years, $SD = 0.53$). With regard to language, 66% of the participants reported that English was their first language. For the other participants, the majority (27%) reported that their first language was of East Asian origin (e.g., Korean, Mandarin, Cantonese) and the remaining 10% indicated a range of other languages (e.g., Spanish, Russian, Polish). Early adolescents whose first language was not English were categorized as students with English as a Second Language (ESL). This range of language backgrounds in the sample is reflective of the cultural and ethnic diversity of the Canadian city in which this research took place. All participants in the current study whose native language was not English, were considered to be competent in reading and speaking the English language by their teachers, and were therefore considered to have adequate English skills to complete all of the measures in the current study. Ethics approval to conduct this research was obtained both from the university, and the school board of the participating school district. Of the total number of early adolescents

recruited for participation, 98% received parental consent and gave assent themselves.

Measures

Demographic information

A demographic questionnaire was administered to each student to gather information about his or her gender, age, grade, first language learned, and family composition.

Executive functions

To assess inhibitory control, we used a computerized Dots task (also see Davidson et al., 2006) in which the central stimuli – a heart or a flower – appeared on the right or left side of the computer screen, requiring participants to press the key either on the same or opposite side of the stimulus (see Fig. 1). The two stimuli were equated for visual characteristics, such as size, color, and luminance. The inhibition task consisted of 33 trials in which either hearts or flowers appeared on the screen in an unpredictable order. Participants were instructed to always press the button on the *same side* (congruent trials), when the stimulus on the screen was a heart, and to press the button on the *opposite side* (incongruent trials), when the stimulus was a flower. Participants therefore had to remember both rules and apply them flexibly. Considering our interest in inhibitory control, the trials of interest in our study were those that require highest inhibitory skills. On those switch trials, participants had to switch from applying the congruent rule to applying the incongruent rule. Switching from congruent (easier rule) to incongruent trials (harder rule) in the mixed condition requires a particularly great exertion of inhibitory control (Davidson et al., 2006).

Performance in inhibitory control trials was operationalized as the percentage of correct responses (PC). PC was calculated by dividing the number of correct responses by the sum of correct and incorrect responses. Anticipatory responses, responses that were faster than 200 ms, were considered too fast to be a response to the stimulus (Davidson et al., 2006), and were thus excluded from the analyses. A response was considered correct if the participant correctly applied the condition-specific rule by pressing the appropriate button on the keyboard, if this occurred no faster than 200 ms after the trial stimulus had appeared, and before the trial stimulus had disappeared. Practice trials as well as the first trial following the practice trials of each block were excluded from analyses. The percentage of correct responses in our study ranged from 25 to 100 with an average of 83 ($SD = 16.1$).

Congruent trials: Press the key on the *same* side as the heart



a) Press left

b) Press right

Incongruent trials: Press the key on the *opposite* side of the flower



a) Press right

b) Press left

Fig. 1. Stimuli and conditions in the dots task.

¹ To rule out intervention effects in the present study, we conducted the analyses in the present study controlling for intervention group. Intervention group was not a significant predictor of math grade in our analyses, and the overall pattern of our results did not change by controlling for intervention group.

Peer acceptance

Acceptance by peers in the classroom was assessed via teacher ratings on the three-item Peer acceptance subscale of the Teacher's Ratings of Social Behavior scale (Eisenberg et al., 2003). On a scale from 1 = *Never* to 5 = *Always*, teachers rated their students on the items "This child finds it hard to make friends," "This child has a lot of friends," and "This child is popular with others at his or her age." The mean peer acceptance score in this study was 3.73 ($SD = 0.86$). Internal consistency for the Peer acceptance scale was satisfactory in this study (Cronbach's $\alpha = .90$). Using teacher ratings in order to assess peer acceptance can have the advantage that classroom teachers have long-term experiences with their students but are less susceptible to systematic biases that can occur in peer-reports, for example when students do not trust that their ratings will be kept confidential (Pepler & Craig, 1998). Even though peer nominations – a measure in which students nominate who of their classmates they like, accept, and want to play with – are a common, established, and valid method of assessing peer acceptance (e.g., Cillessen, 2009; Wentzel, Barry, & Caldwell, 2004; Younger, Schneider, Guirguis, & Bergeron, 2000), concerns have been raised in the past. For example, Bell-Dolan and Wessler (1994) have raised ethical concerns about sociometric peer ratings and nominations in the past, including the risk of increasing negative social interactions and marginalization in the classroom that can occur when peers rate each other as "less liked" and "less accepted." Previous studies that have employed teacher ratings of peer acceptance have found significant relations between teacher-rated acceptance and higher perceptions of having a close and supportive friends, lower self-reported depressive symptoms, and higher self-worth in early adolescence (see Klima & Ripetti, 2008).

Math achievement

Math achievement was assessed via students' end of the school year math grades obtained from school records. The schools provided grades for 89 of the students. Grades were recorded on a continuous scales ranging from 1 = C– to 9 = A+. Twenty students' math grade fell in the range of C– to C+, 29 were in the range of B– to B+, and 39 were in the range of A– to A+. The mean grade was 5.6 ($SD = 2.3$).

Procedure

Peer acceptance and inhibitory control were assessed in the early spring in the school year. Self-report data (i.e., demographics) were assessed in form of a brief survey. The classroom teachers completed teacher ratings of peer acceptance within 1 week, rating each of the participating students in their classroom individually. Given that the data collection took place towards the end of the school year, we can assume that each classroom teacher knew the students in his or her classroom reasonably well. The EF task assessment took place outside of the classroom in a quiet room with no distractions. Early adolescents were told that they were going to play a computer game for the next 10 min in which hearts and flowers appear on the screen, and they had to press one of the two marked buttons on the left or right side of the keyboard depending on which rule they were instructed to apply. The task was presented on a laptop using the *Presentation* program by *Neurobehavioral*

Table 2

Regression analysis predicting math achievement from peer acceptance and inhibitory control skills.

	Model	B	Standard error	β	t-value	Sig.
1	Inhibitory control	.03	.02	.22	2.06	<.05
2	Inhibitory control	.02	.02	.13	1.18	ns
	Peer acceptance	.94	.30	.33	3.17	<.01

Systems to present stimuli and record responses. Responses were collected via two input keys on the keyboard. Participants were positioned approximately 50 cm from the screen. The task consisted of three different conditions. Each condition began with condition-specific instructions and a short block of four practice trials. The practice trials consisted of all relevant trials types included in the task condition. If necessary, the practice trials were repeated, to ensure that the participant had understood the task and the condition-specific requirements. Stimulus presentation time was 750 ms, and the interstimulus time interval was 500 ms. We obtained each participant's end of the school year math grades from schools after final grades had been assigned and released.

Results

Correlations and hierarchical linear regression analysis

The outcome measure was math grades, and the predictor variables of interest were performance on high demand inhibitory control trials and peer acceptance. Preliminary analyses were conducted to ensure that the data did not violate any of the assumptions for hierarchical regression analysis. Normal distribution of the residuals, linearity, multicollinearity, heteroscedacity, and independence of errors assumption were not violated. Missing data were excluded pair wise from the regression analyses (Pallant, 2007).

We began by conducting a correlational analysis among all of our variables included in the regression model (see Table 1). Results revealed positive and significant correlations among all three variables of interest: Inhibitory control, math grades, and peer acceptance. Next, we conducted a hierarchical linear regression analysis in which inhibitory control was entered in a first step, and peer acceptance was entered in a second step (see Table 2). Results revealed that the overall Model 1 was significant [adjusted $R^2 = .04$, $F(1, 87) = 4.23$, $p < .01$], indicating that inhibitory control significantly predicted math grades in the model [$\beta = .21$, $p < .05$]. Peer acceptance, when entered in the second step of the hierarchical regression (Model 2), significantly predicted math grades above and beyond the effects of inhibitory control [adjusted $R^2 = .12$, $F(2, 86) = 7.36$, $p < .01$]. Additionally, the change between Models 1 and 2 was statistically significant [R^2 change = .10, $F(1, 86) = 10.06$, $p < .01$]. In the full model, peer acceptance was a significant predictor [$\beta = .33$, $p < .01$] whereas inhibitory control was no longer statistically significant [$\beta = .12$, ns].² Given that inhibitory control was significantly and positively related to math grades in the first step of the hierarchical linear regression, the absence of a significant relationship when entered simultaneously with peer acceptance in Model 2 of the regression provided the rationale for testing whether peer acceptance was statistically mediating the relationship between inhibitory control and math grades in our study (Baron & Kenny, 1986).

Table 1
Intercorrelations among math grades, peer acceptance, and inhibitory control.

	1	2	3
1. Math grades	–		
2. Peer acceptance	.36***	–	
3. Inhibitory control	.22*	.28**	–

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

² Using ESL, age, and gender as control variables in the model revealed that none of the variables was a significant predictor, nor did any of them alter the overall results of the model. We therefore did not include those variables in subsequent analyses to increase power.

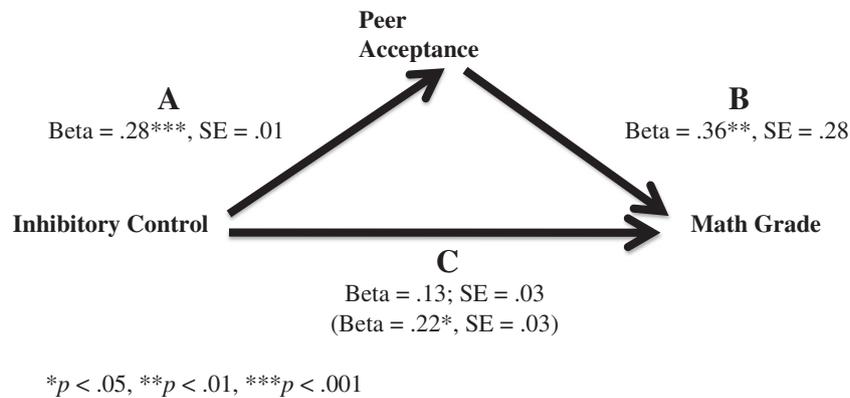


Fig. 2. Model with peer-acceptance as a mediator between inhibitory control skills and math grades.

Mediation analysis

To test the potential role of peer acceptance as a statistical mediator between inhibitory control and math grades in our study, we used the bootstrapping procedure for SPSS described by Preacher and Hayes (2004). As suggested by MacKinnon, Lockwood, Hoffman, West, and Sheets (2002), the bootstrapping procedure is a more appropriate test for mediation in the case of small sample size than the Sobel test because bootstrapping has more statistical power. The bootstrapping analysis was used to test the null hypothesis that the indirect path from inhibitory control to math grades through peer acceptance was not significantly different than zero (see Fig. 2). The 95% confidence interval values ranged from .0031 to .0299. Because the confidence interval did not cross zero, this result disconfirmed the null hypothesis, and indicated that peer acceptance was a statistically significant mediator between inhibitory control and math grades in our study.³ Given that the change in explained variance from Model 1 to Model 2 in our regression analysis was .10 as reported above, peer acceptance accounted for 10% of the variation in math grades in our study.

Discussion

This investigation furthers our understanding of the importance of peer acceptance in the classroom for academic success. In particular, the findings of the current study suggest that both cognitive indicators of self-regulation and indicators of peer acceptance need to be investigated simultaneously when understanding academic achievement in early adolescence. In the following paragraphs, we outline our findings and discuss them embedded in the existing literature. Last, we consider the relevance of these findings, limitations, and future considerations.

As expected, we found that both peer acceptance and inhibitory control were significantly and positively related to academic achievement in the domain of math in our study. We also found that peer acceptance and inhibitory control were significantly and positively related to each other. Furthermore, as expected, peer acceptance emerged as a significant mediator between inhibitory control and math achievement when all three variables were examined simultaneously. These findings are important because they suggest that in addition to cognitive functioning, social acceptance in the classroom plays an important role in academic success. In addition, our findings suggest that peer acceptance provides a link between inhibitory control skills and achievement in math in early adolescence.

³ To rule out alternative explanations, we also tested whether math performance mediated the link between inhibitory control and peer acceptance in our study. We found that the relationship between inhibitory control ($\beta = .21, p < .05$) and peer acceptance remained significant when controlling for math performance ($\beta = .32, p < .01$) in the regression analysis. Hence, there was no support for math performance as a potential mediator in the model.

The positive relationship that was revealed between peer acceptance and math achievement is in accord with previous research conducted with early adolescents (e.g., Véronneau et al., 2008; Wentzel, 2009; Wentzel & Caldwell, 1997). Overall, peer acceptance has been identified as an important marker of successful development that is positively related to social well-being and academic achievement throughout adolescence (Bierman, 2004; Furrer & Skinner, 2003; Nangle & Erdley, 2001; Véronneau & Vitaro, 2007; Wentzel, 1991; Wentzel & Caldwell, 1997). In fact, young people benefit socially and also academically from being part of a peer group in school, and they benefit in particular from being surrounded by highly motivated peers (Véronneau et al., 2010; Wentzel, 2003), and peer acceptance overall can be seen as a powerful influence on individuals' academic engagement and growth in early adolescence.

Similarly, the positive role of inhibitory control in academic achievement we found in the present study has been established in past research. In fact, inhibitory control – a core indicator of cognitive executive control that is indicative of self-regulatory abilities (Blair & Diamond, 2008) – has been significantly related to overall academic achievement in preschool-aged children, and in particular to achievement in math in past research (Blair & Razza, 2007; Espy et al., 2004; Van der Ven, Kroesbergen, Boom, & Lesemann, 2012). At the same time, inhibitory control is considered to be a core skill needed for social functioning, such as forming positive relationships with peers (Hay et al., 2004; Hughes & Ensor, 2010). Inhibitory control skills and peer acceptance have both been implicated as important factors for good self-regulation skills (Davidson et al., 2006; Olsen et al., 2003). Self-regulation in turn has been identified as a core predictor for adjustment in the school setting – socially and academically (Blair & Diamond, 2008). Hence, our finding that peer acceptance and inhibitory control are positively and significantly related with one another is in accord with past research (Hughes et al., 2000).

The unique contribution of this study was that we investigated both inhibitory control and peer acceptance simultaneously in relation to academic achievement in early adolescence. Analyses revealed that peer acceptance significantly mediated the relationship between early adolescents' inhibitory control and academic achievement in math. Hence, based on our findings, peer acceptance as a predictor of academic achievement accounted for the link between inhibitory control and math grades. Unpacking this finding, it is likely that early adolescents with poor inhibitory control are also less likely to engage in positive social relationships and are thus less likely to be accepted by their peers. A lower degree of peer acceptance in the classroom in turn is related to poorer academic achievement (Bierman, 2004; Wentzel, 2009). Possibly these students are less motivated and engaged in the school setting because they do not feel a sense of acceptance by peers and belonging in the classroom (Witkow & Fuligni, 2010). Acceptance by peers in the classroom has been identified as a positive indicator for involvement,

and is ultimately positively related to academic success (e.g., Furrer & Skinner, 2003). This finding aligns with recent research conducted by Valiente et al. (2008) with children in middle childhood. Specifically, the authors found that school relationships (i.e., between student and teacher) as well as classroom participation significantly mediated the relationship between effortful control – an indicator of self-regulation which is positively related to inhibitory control skills (Rothbart & Bates, 2006) – and change in academic achievement from the beginning to the end of the school year.

The current findings are important because they urge researchers to increase their focus on social aspects of development in addition to cognitive development when understanding academic achievement in school. Specifically, our findings suggest that indicators of positive relationships – such as peer acceptance – cannot be ignored when examining academic growth in early adolescence. The strength of this study is the joint examination of cognitive and social indicators of well-being in relation to academic achievement in elementary school – two areas of research that to our knowledge have rarely been combined in the developmental period of early adolescence. From a practical perspective, these findings are valuable considering their informative value for the design of classroom-based prevention and intervention strategies. As for intervention programs, young people could benefit socially but also academically from programs that combine strategies to enhance EFs (e.g., by addressing self-regulation skills) and peer relationships in the classroom setting at the same time. In particular, our findings suggest that efforts to promote positive relationships and acceptance among peers in the classroom may be crucial because they can have an effect on both, individuals' social-emotional well-being as well as academic success.

A few shortcomings of this study need to be considered. First, this study is based on a relatively small sample size using cross-sectional data. Future research needs to be conducted investigating the relationships among inhibitory control, peer acceptance, and math grades longitudinally and in a larger sample. As past research and theory have suggested, the importance of social acceptance in the peer group rapidly increases with the onset of adolescence (e.g., see Wentzel et al., 2004; Wigfield, Byrnes, & Eccles, 2006). Compared to the early childhood years in which the social focus rests on the family, the transition to early adolescence is characterized by a shift in social focus toward the peer group (Eccles & Roeser, 2009). Therefore it is possible that peer acceptance as a mediating link between inhibitory control skills and math achievement is specific to the developmental period of early adolescence. Based on this consideration, a developmental investigation of the interrelations of executive function skills, social acceptance in the peer group, and academic achievement needs to be conducted to understand the generalizability of our finding to other age groups, and to reveal whether the role of peer acceptance changes during specific sub-stages throughout the adolescent years.

Second, further considering the generalizability of our findings, more research needs to be conducted with specific sub-groups of the population. The current sample was a non-clinical middle class sample. It is unclear how our findings would generalize to early adolescents identified as exhibiting high-risk behaviors. For instance, given that peer pressure can encourage young adolescents to engage in risky behaviors, it is possible that in high-risk youth, lower self regulation (e.g., indicated through high-risk behaviors such as sexual risk taking and substance use) is associated with dominance and more social acceptance (Gardner & Steinberg, 2005; Magar, Phillips, & Hosie, 2008; Raffaelli & Crockett, 2003).

Third, it is important for future studies to examine peer relationships with self-, peer-, and teacher-reported measures, and to relate them to several indicators of academic achievement to understand whether the findings in our study generalize to other domains of achievement. Last, future research needs to explore other indicators of positive social functioning in addition to peer acceptance (e.g., positive relationships with teachers), to explore potentially more mediators that account for the

link between executive skills and academic success in the school context. A last limitation is that math grades were obtained at the end of the school year, following a social and emotional competence intervention that had taken place in two of the four classrooms included in our study. Even though an intervention effect cannot conclusively be ruled out, there was no evidence that the intervention significantly influenced our results given that the overall pattern of the present findings in this study remained stable controlling for exposure to the intervention.

In sum, the present study was designed to address several of the extant gaps in the literature by examining the relations among inhibitory control, peer acceptance, and school achievement during early adolescence. Our results indicated that both inhibitory control and peer acceptance play significant roles in early adolescents' academic success in the classroom. Given our results, more research on the role of social functioning – such as peer acceptance – in mediating the relationship between self-regulation and achievement in early adolescence with diverse samples is clearly warranted.

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