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Temperament and Social Problem Solving Competence in Preschool: Influences on Academic Skills in Early Elementary School

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Abstract

The goals of the current study were to examine whether children's social problem solving (SPS) skills are a mechanism through which temperament influences later academic achievement and whether sex moderates these associations. Participants included 1,117 children enrolled in the NICHD Early Child Care Study. During preschool, mothers and childcare providers rated children's temperamental shyness and inhibitory control, and SPS was assessed using a hypothetical-reflective measure during a laboratory visit. During kindergarten and first grade, teacher-report of math and language skills was collected. Results indicated that high ratings of inhibitory control in preschool, but not shyness, predicted better kindergarten and first grade academic skills. Furthermore, children's SPS competence mediated the relations between both shyness and inhibitory control on later academic skills. The child's sex did not moderate these associations. Results suggest that preventative efforts targeting early SPS skills may buffer against later academic adjustment problems among temperamentally extreme children.

Keywords

Shyness; inhibitory control; social behavior; academic achievement

At the beginning of the school year, children must meet and interact with unfamiliar peers and adults and join a developing network of peer and adult relationships (Ladd, 1990; Ladd, Birch, & Buhs, 1999; Ladd, Herald, & Kochel, 2006). One aspect of children's social competence that may influence adjustment in school is their ability to solve problems during challenging social interactions. As children develop more competent social problem solving (SPS) skills over time, they are rated as better adjusted behaviorally and academically (Dubow, Tisak, Causey, Hryshko, & Reid, 1991). Furthermore, individual differences in temperament also influence the development of SPS skills and academic outcomes (Coplan & Arbeau, 2008; Rubin & Rose-Krasnor, 1992). Thus, SPS competency appears to be an important developmental correlate of social and academic adjustment in school. The purposes of the current study were to examine 1) whether SPS competence is a mechanism through which temperament influences later academic skills and 2) whether these associations are comparable for boys and girls.

Temperament

Temperament describes biologically based individual differences in the quality and intensity of children's emotional reactions (Rothbart & Bates, 2006). Temperamentally based

behaviors can be classified into one of two domains: reactivity and self-regulation. Reactivity is the speed, strength, and valence of behavioral and physiological responses to environmental stimuli and self-regulation describes neural and behavioral processes that modulate a child's reactivity (Rothbart & Bates, 2006; Rothbart & Derryberry, 2002). Social withdrawal is behavioral solitude that originates from factors internal to a child such as strong physiological reactions to novelty (e.g., temperamental shyness) or a preference for playing alone (i.e., social disinterest; Rubin, Coplan, & Bowker, 2009). Shyness is a dimension of temperamental reactivity that refers to fear and unease in response to novel social situations. Shy children appear motivated to interact with others, however, the fear and distress associated with novelty leads to withdrawal from the social situation (Coplan, Prakash, O'Neil, & Armer, 2004; Crozier, 2000). Inhibitory control, however, is an aspect of self-regulation defined as the ability to avoid a dominant response in favor of a subdominant response (Henderson & Wachs, 2007; Jones, Rothbart, & Posner, 2003). Shyness and inhibitory control influence the quality and quantity of children's social behavior (e.g., peer and teacher interactions in the classroom) and their academic skills. Therefore, temperament may have both direct and indirect relations to academic achievement through children's social interactions in school.

Temperament and Academic Achievement

Temperamental reactivity and self-regulation have both been studied in relation to academic achievement. Specifically, temperamental reactivity (e.g., shyness, anger, sadness) is negatively associated with academic achievement while effortful control is positively associated with achievement (Valiente, Lemery-Chalfant, & Swanson, 2010; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008; Valiente, Swanson, & Eisenberg, *in press*). Shy children may perform similarly to peers on academic performance during early elementary school; however, they begin to lag behind peers in the school performance over time (Asendorpf & van Aken, 1999). In preschool and kindergarten, shy children spend more time displaying wary behaviors, such as staring, more time in solitary passive play, and less time interacting with their peers in the classroom (Asendorpf, 1991; Gersten, 1989; Rimm-Kaufman & Kagan, 2005). Furthermore, shy children are less likely to speak upon arrival to school and during breaks, are less likely to volunteer answers in teacher-guided activities, and even speak less at home (Asendorpf & Meier, 1993; Rimm-Kaufman & Kagan, 2005; Spere, Evans, Hendry, & Mansell, 2009). Children displaying shyness in the classroom also display poorer social and academic competence as rated by parents, teachers, and direct assessment (Coplan, Gavinski-Molina, Lagacé-Séguin, & Wichmann, 2001). Shyness might negatively impact academic performance because shy children experience heightened fear, sadness, anxiety, and physiological arousal in the classroom, which may directly influence classroom learning by disrupting attention and information processing. Shy children may also seek out and elicit fewer interactions with teachers and peers, resulting in fewer opportunities to gain important social and academic skills (Coplan et al., 2001; Rubin, Fein & Vandenberg, 1983; Spere & Evans, 2009).

Inhibitory control is concurrently and longitudinally related to early math and reading achievement in preschool and early elementary school, even after controlling for various demographic characteristics and/or prior achievement (Blair & Razza, 2007; Clark, Pritchard, & Woodward, 2010; Espy et al., 2004). It is possible that inhibitory control is an important predictor of social and academic functioning in school because it facilitates formal classroom learning and informal learning in peer and classroom contexts. In Rothbart's model of temperament, self-regulatory abilities are indexed by the effortful control factor which combines inhibitory control with other types of cognitive and social regulation abilities (e.g., smiling/laughter, attentional focusing; Rothbart, Ahadi, Hershey, & Fisher, 2001). Effortful control has also been found to predict academic achievement from

preschool through middle school (Deater-Deckard, Mullineaux, Petrill, & Thompson, 2009; Fabes, Martin, Hanish, Anders, & Madden-Derdich, 2009; McClelland et al., 2007; Valiente, Lemery-Chalfant, K., & Castro, 2007). However, some have found that inhibitory control uniquely predicts academic achievement, beyond the effects of attention and working memory (Blair & Razza, 2007; Espy et al., 2004).

In 7- to 12-year old children, parent and self-report of effortful control predicts change in GPA in part through the influence on social competence (Valiente et al, 2008). One aspect of children's social competence that may influence academic achievement is the ability to solve problems during challenging social interactions. Social problem-solving (SPS) abilities are defined as the strategies used to achieve a personal goal (e.g., strategies for getting peers to comply) during challenging social situations (Rubin & Krasnor, 1983). The ability to inhibit a predominant response (i.e., inhibitory control) may be particularly important for SPS behavior as children must be able to enact a socially appropriate behavior during SPS (e.g., waiting their turn) and inhibit socially inappropriate behaviors (e.g., impulsively taking a toy from their peer). Therefore, the current study focused on the influence of shyness and inhibitory control on academic skills, and whether SPS skills mediated these relations.

Temperament and SPS

Stewart and Rubin (1995) examined the concurrent association between social withdrawal and SPS among kindergarten, second, and fourth grade children. They found that socially withdrawn children were less likely to initiate interactions with an unfamiliar peer and made fewer social problem-solving attempts than their more sociable peers regardless of age. Of the attempts that were made, withdrawn children made more indirect requests, fewer commands, and failed more often than their more sociable peers at all ages. In a downward extension of Stewart and Rubin (1995), Moas and Henderson (2009) brought two same-sex unfamiliar peers to the laboratory, gave them one toy, and instructed them to share. Results indicated that maternal report of shyness at age two was longitudinally associated with less time engaged with the toy and fewer attempts to get the toy from a peer at two, three, and four years of age. When shy children did make attempts, they used fewer competent strategies than less shy peers at all ages, although shyness did not relate to their rates of success. Therefore, it appears that as early as toddlerhood, shy children were more likely to use subtle means to attain their goals during challenging social situations. Furthermore, there is evidence that early shyness negatively predicts the development of SPS abilities during the toddler and preschool years (Moas & Henderson, 2009), suggesting that SPS abilities may be a mechanism linking shyness to academic achievement.

Inhibitory control is strongly associated with social behavior and interaction. Specifically, inhibitory control, measured directly in preschool, is concurrently related to teacher ratings of social-emotional competence controlling for maternal education and employment, sex, race, receptive vocabulary, emotional knowledge, and attention skills (Rhoades, Greenberg, & Domitrovich, 2009). Few studies, however, have specifically examined the relations between inhibitory control and SPS. Some have found that inhibitory control is positively related to both teacher report and observations of cooperative behavior and negatively related to observations of non-cooperative behavior throughout elementary school (Ciairano, Visu-Petra, & Settanni, 2007; Rudasill & Konold, 2008). In one study, interviewer-report of self-regulation, composed of inhibitory control, executive attention, and emotion regulation, was positively associated with maternal report of social competence, direct assessment of academic achievement and grades, and self-report of SPS, yet negatively associated with maternal report of problem behaviors, depression, and anxiety in 8- to 18-year-old low-income children (Buckner, Mezzacappa, & Beardslee, 2009). Therefore, while shyness may

negatively influence social and academic development, inhibitory control may serve as a protective factor that promotes various adaptive behaviors. The current study extends the literature by 1) utilizing a longitudinal design to examine the direct effects of both shyness and inhibitory control on both SPS and academic achievement, and 2) examining whether SPS competence mediates the relations between temperament and academic achievement.

Sex Differences

Various studies have examined sex differences in mean levels of temperament, SPS, and academic skills. Minimal to no mean differences have been found between boys and girls on shyness (see Rubin, Coplan & Bowker, 2009 for a review), however, girls are rated and observed to be higher than boys on effortful control (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Valiente et al., 2007, 2008, 2011). From toddlerhood to kindergarten, girls self-report more competent SPS solutions and are less likely to use aggressive strategies and retaliation than boys (Carson, Wagner, & Schultz, 2001; Rubin & Krasnor, 1983; Walker, Irving, & Berthelsen, 2002). Sex differences in academic achievement are mixed, with some reporting that girls score and are rated higher than boys on literacy, social studies, math, science, and overall achievement (e.g., Pomerantz, Altermatt, & Saxon, 2002; Valiente et al., 2007, 2008, 2011); others finding that children and parents report that boys outperform girls on math skills (e.g., Herbert & Stipek, 2005); and still others finding no differences between boys and girls on parent-report, teacher-report and direct assessment of academic achievement (Herbert & Stipek, 2005; Valiente et al., 2010).

Although mean levels of temperament, SPS, and academic skills may differ between boys and girls, little is known about whether the paths linking these constructs also differ between children. Coplan et al. (2001) found that some forms of non-social play relate to social and adjustment outcomes differently for boys and girls. However, they also found that displays of reticent behavior in the kindergarten classroom were positively associated with maternal report of shyness and negatively associated with teacher and direct assessment of social and academic competence, regardless of sex (Coplan et al., 2001). Similarly, sex does not moderate the direct or indirect relations between effortful control and academic outcomes (Valiente et al., 2007, 2011). The current study examined whether boys and girls differ on the associations between both shyness and inhibitory control on SPS and academic skills.

Current Study Hypotheses

The current study utilized a multi-method approach and longitudinal design to examine whether SPS is a mechanism linking temperament to later academic achievement. Specifically, the current study incorporated information from maternal and childcare provider report of temperament in preschool, child self-report of SPS in preschool, and teacher report of children's academic skills in kindergarten and first grade. Furthermore, though temperament and SPS were collected concurrently, children's academic skills were measured one and two years later to test for the lasting effects of temperament and SPS on academics. Because temperament is biologically based, appears early in life, and is relatively stable (Rothbart & Bates, 2006), shyness and inhibitory control were included as predictors of SPS and later academic skills (see Figure 1). It was expected that shyness would be negatively associated with SPS competence and academic skills while inhibitory control would be positively associated with SPS competence and academic skills. We also hypothesized that SPS competence would mediate the associations between shyness and inhibitory control on later academic skills. In addition, we expected the magnitude of the associations between the constructs to be the same for boys and girls.

Method

Participants

One thousand one hundred and seventeen (570 boys, 547 girls) children participated in the National Institute of Child Health and Human Development study of Early Child Care and Youth Development (NICHD ECCYD). Families were recruited just after birth and were followed until the child was 15 years of age. Phase II data collected during preschool ($M_{age} = 56$ months, $SD = 1$ month), kindergarten ($M_{age} = 67.89$ months, $SD = 3.54$ months), and first grade ($M_{age} = 83$ months, $SD = 3.78$ months) were used for the current study. Parent report of child race and ethnicity was reported as follows: 82% Caucasian, 12% African-American, 1% Asian, less than 1% American Indian, Eskimo, or Aleutian, and 4% other. Of these children, 6% were also identified as Hispanic. When children were one month of age, maternal age ranged from 18 to 46 years ($M = 28.44$ years, $SD = 5.547$ years), maternal years of education ranged from seven to twenty-one ($M = 14.39$, $SD = 2.48$), and total family income ranged from \$2,500 to \$275,001 ($M = \$39,061$, $SD = \$33,603$).

Participants were recruited for the NICHD ECCYD study from hospitals in 10 research locations across the country in 1991. Mothers of multiple births, under the age of 18, and/or non-fluent English speakers were not contacted. Due to the childcare nature of the NICHD ECCYD study, mothers were initially recruited to represent mothers who were working full-time during the child's first year as well as part-time working mothers and non-working mothers. Selected families were representative of the diversity in race/ethnicity, family structure, and socioeconomic status of the areas in which they lived.

The NICHD ECCYD study enrolled 1,364 children; however, 247 children were excluded from the current study due to missing data on all variables. Therefore, 1,117 children with partial or complete data were included in analyses. Consistent with past studies utilizing the NICHD ECCYD data (e.g., Campbell et al., 2010; Pleuss & Belsky, 2009), attrition analyses revealed that at study enrollment, mothers of children with missing data on all variables were younger ($M's = 26.60$ vs. 28.44 years; $t(1,362) = -4.706$, $p < .01$), reported fewer years of education ($M's = 13.53$ vs. 14.39 years; $t(1,361) = -4.878$, $p < .01$), and had a lower income ($M's = \$32,647$ vs. $\$39,061$; $t(1,271) = -2.547$, $p = .01$) than mothers of children with at least partial data. There were no differences between children with missing data and children with partial or complete data on sex, $\chi^2(N = 1364, 1) = 1.065$, $p = .30$, however, children with missing data were more likely to be of a racial or ethnic minority (24%) than children with at least partial data (16%), $\chi^2(N = 1364, 1) = 10.629$, $p = .001$. Most importantly to the current study, there were no differences between the groups on early maternal report of temperament on the Infant Temperament Questionnaire (Carey & McDevitt, 1978) at 6 months of age: approach, $t(1,271) = .36$, $p = .72$; activity level, $t(1,276) = .62$, $p = .54$; intensity, $t(1,275) = .31$, $p = .76$; or adaptability $t(1,265) = .66$, $p = .51$.

Procedure

Maternal and childcare provider report (i.e., caregivers at child care centers and in-home caregivers where care was provided at either the caregiver's home or the child's home) of shyness and inhibitory control were collected using the Children's Behavior Questionnaire at 54 months of age during a laboratory visit and childcare center visit, respectively. During the 54-month laboratory visit, children completed the Social Problem Solving Test, a hypothetical-reflective interview that measures children's SPS. Children's kindergarten and first grade academic skills were assessed using teacher ratings of their performance in mathematical thinking and language and literacy skills.

Measures

Temperament—The Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) is a 195-item measure used as a parent and childcare provider report of temperament. Parents and childcare providers rated child's reactions to different situations in the past 6 months on a 7-point scale, with one being that the behavior is "extremely untrue" and seven being "extremely true." The measure was standardized using 262 children between the ages of three to seven years. Of the 15 temperament scales on the CBQ, the NICHD ECCYD Study had childcare providers complete items pertaining to the dimensions of anger/frustration, inhibitory control, shyness, sadness, and attentional focusing. Mothers completed items pertaining to the dimensions of approach, activity level, shyness, fear, anger/frustration, sadness, inhibitory control, and attentional focusing.

Of interest in the current study were the dimension of shyness and inhibitory control. On both childcare provider and maternal forms, high scores on shyness indicated slow or inhibited approach behavior during novel or uncertain social situations. Inhibitory control assessed the ability to plan and inhibit dominant behavior when instructed or during uncertain novel situations. Cronbach's alphas were .90 and .85 for childcare provider report of shyness and inhibitory control, respectively, and .85 and .75 for maternal report of shyness and inhibitory control for the NICHD ECCYD study.

SPS—The Social Problem Solving Test revised (SPST; Rubin, 1983) is a hypothetical-reflective measure of children's SPS. This assessment is widely used and appropriate for children as young as 3 years of age. The NICHD ECCYD study reduced the number of stories from eight to five to reduce assessment time. During the assessment, children were shown five drawings and read stories of problem situations, three of which were related to object acquisition and two related to friendship. In object acquisition stories, the story character wanted to gain possession of a toy or material that the other child possessed. For example, "This boy's name is Rick and this is Danny. Rick is four-years-old. Danny is five-years-old. Danny is older than Rick. Danny has been on the swing for a long, long time. Rick would really like to play on the swing." In friendship stories, one child would like to meet and become friends with another child. For example, "This girl's name is Kim and this is Jenny. Kim and Jenny are both four-years-old. They are both the same age. This is Jenny's first day at preschool. Kim would like to be friends with Jenny." After seeing the picture and listening to the story, the child being assessed was asked for two things the character should say or do in each problem situation. The child was then asked what s/he would do in that situation.

Children's responses were later coded for types of solution, relevancy, and flexibility. Solutions given during the object acquisition stories were coded into fifteen categories (multiple categories could be coded for a single response): ask, politeness, tell-agonistic, tell-prosocial, wait, authority, fair share, turns, trade, bribe, plan for future, manipulate affect, force, grab, physical attack on person, damage to property, loan, or finagle. Solutions given during the friendship stories were coded into seven categories (multiple categories could be coded for a single response): invitation, prosocial and complimentary, adult intervention, conversation openers, indirect initiation, direct initiation, and non-normative. The first and second responses for each story were coded for relevance as either zero or one, where a one indicates that the child was able to generate a greater number of solutions that could realistically solve the problem. A flexibility score is given based on the first two responses on a scale of zero to three, with higher numbers indicating a greater ability to generate novel solutions to the problem, when the first solution was unsuccessful. Two coders each coded 40 reliability cases in sets of 10. Each set of 10 cases, included a randomly selected case from each site. Inter-rater reliability (Cohen's Kappa) for object

acquisition stories was .91 for categories, .89 for relevancy, and .88 for flexibility. For friendship stories, inter-rater reliability was .91 for categories, .88 for relevancy, and .83 for flexibility.

Four SPS competence variables were created using the data described above. The first variable was the proportion of prosocial responses for object acquisition stories. This variable was created by summing first the frequency of ask, politeness, tell-prosocial, wait, fair share, plan for future, and loan and then dividing by the total number of responses given during object acquisition stories. Similarly, the proportion of prosocial responses given for friendship stories was created by dividing the frequency of prosocial and complimentary over the total number of responses given for friendship stories. The average flexibility of scores was also calculated by summing the scores for all stories and dividing them by five. Last, the total number of different categories each child suggested across the five stories was calculated. The range of the total number of categories suggested by children was from zero to fifteen, with higher numbers indicating that the child was able to produce a greater variety of possible solutions. These four variables were standardized and summed to create the SPS competence variable (Cronbach's $\alpha = .67$), with higher scores indicating better problem solving across all stories.

Academic skills—The Academic Rating Scale (Rock & Pollack, 2002) is a teacher-report measure of academic skills developed for use in the Early Childhood Longitudinal Study. The measure gives scores on three scales: language and literacy, general knowledge (i.e., social studies and science skills), and mathematical thinking. For the NICHD ECCYD study, teachers responded to the items pertaining to language and literacy (13 items; 15 items for kindergarten and first grade, respectively) and mathematical thinking (15 items; 10 items). Items were constructed differently at each grade level to reflect developmental differences in the expression of academic skills over time. The language and literacy subscale measures children's skills and behaviors related to listening, speaking, early reading, and early writing. The math subscale measures children's ability to perceive, understand, and utilize skills to solve mathematical problems.

Teachers were asked to rate the target child's skills and behaviors on a range of contexts and situations and compare them to other children of the same age and grade level. Items are answered on a 5-point scale, ranging from "not yet demonstrated" through "proficiency." Mean scores were created for each subscale by summing responses to items relevant to that particular subscale and dividing by the total number of items used in that subscale. Cronbach's alphas for teacher report of language and math were .95 and .97 at kindergarten and .96 and .94 during first grade for the NICHD ECCYD study.

Analytic Strategy

Preliminary correlations and independent samples *t*-tests were conducted to examine whether age and sex, respectively, were related to the constructs of interest. Then, to test the hypothesized associations between temperament, SPS, and academic skills, a structural equation model (SEM) was examined using *Mplus* Version 5 (Muthén & Muthén, 1998–2007). First, a measurement model was created by combining information from multiple informants and time points to create latent variables of shyness, inhibitory control, and academic skills. To ensure that the latent variables were measuring the same constructs between boys and girls, measurement invariance was tested by constraining each latent variable loading and indicator intercept equal between boys and girls. The constrained model was then compared using a chi-square difference test to a model in which the loading or intercept was allowed to vary. Each loading and intercept was tested individually beginning with the loadings.

Second, a structural model was created to test for the direct effects of shyness and inhibitory control on SPS competence and academic skills, the direct effect of SPS on academic skills, and the indirect effects of the temperament variables on academic skills through SPS competence (see Figure 1). Bias-corrected bootstrap confidence intervals were calculated to test the strength of the mediation effect, as this approach is considered superior to other tests of indirect effects (MacKinnon, Lockwood, & Williams, 2004; Williams & MacKinnon, 2008). These associations were all tested using a multiple group analysis to examine the moderating role of sex on the hypothesized direct and indirect associations. To test for moderation, each path was first constrained to be equal between boys and girls and then allowed to vary across groups. Chi-square difference tests were examined to determine whether the model resulted in better fit with the path constrained or free to vary between boys and girls.

Results

Descriptive and Preliminary Analyses

Descriptive statistics and correlations are presented in Table 1. Preliminary correlations revealed that maternal and childcare provider reports of shyness were more moderately correlated and reports of inhibitory control were also moderately correlated. However, there were low correlations between shyness and inhibitory control variables. Furthermore, inhibitory control was positively related to SPS and academic measures, while shyness correlated negatively with SPS competence.

Age was not related to shyness, inhibitory control or SPS competence. There was, however, a small association between age and academic skills (r 's = .10 – .14, p 's < .001).

Residualized scores were calculated to remove the effect of age on academic skills. Results of the multiple group analyses utilizing residualized scores for academic skills were the same as those with the original scores. Therefore, for ease of interpretation, the following models were conducted with the original academic skills variables.

Mean differences between boys and girls on temperament, SPS, and academic skills were examined using independent samples t -tests. Girls were rated as significantly higher than boys on maternal report of shyness, maternal and caregiver report of inhibitory control, and teacher report of kindergarten language and math skills and first grade language skills. Girls also scored higher than boys on SPS competence. See Table 2 for results and descriptive statistics.

Structural Equation Modeling

Measurement model—Results of the chi-square difference tests indicated that the loading of language in kindergarten and intercepts of maternal report of shyness, first grade language, and first grade math should be free to vary between boys and girls. The first latent variable, shyness, included maternal and childcare provider report of shyness from the CBQ. Unstandardized loadings (constrained equal between boys and girls) were 1.00 for maternal report and 1.48 for childcare provider report. The second variable, inhibitory control, included maternal and childcare provider report of inhibitory control from the CBQ with loadings of 1.00 and 1.42 (constrained to be equal for boys and girls). The outcome, academic skills, included language and math skills measured in kindergarten and language and math skills measured in first grade. Factor loadings were .95 for math in kindergarten, .95 for first grade language, and .83 for first grade math and were constrained to be equal for boys and girls. Loadings for kindergarten language were allowed to vary across groups resulting in a value of 1.00 for boys and 1.18 for girls. All factor loadings were significant (p < .001).

Errors of the academic skills indicators were correlated due to shared method variance (i.e., teachers reported on both language and math competence at a given time point). The errors of teacher report of language and math in kindergarten were correlated at .32 for boys and .27 for girls. The errors of language and math in first grade were correlated at .33 for boys and .40 for girls.

Structural model—As expected, ratings of shyness were negatively associated with SPS competence ($b = -.82$, $SE = .21$, $p < .001$), and ratings of inhibitory control were positively associated with SPS competence ($b = 1.08$, $SE = .27$, $p < .001$). Contrary to hypothesis, shyness did not directly predict academic skills ($b = -.11$, $SE = .07$, $p = .12$); however, higher inhibitory control ($b = .76$, $SE = .13$, $p < .001$) and SPS competence ($b = .04$, $SE = .01$, $p = .001$) did predict higher academic skills. While shyness did not directly predict academic skills, there was a significant indirect effect of shyness on academic skills through SPS competence ($b = -.04$, $SE = .01$, $p = .012$, $CI_{95\%}$ from $-.07$ to $-.01$) controlling for inhibitory control, suggesting that the relation between shyness and academic skills is mediated through SPS competence. Furthermore, there was also a significant indirect effect of inhibitory control on academic skills through SPS competence ($b = .05$, $SE = .02$, $p = .001$, $CI_{95\%}$ from $.02$ to $.08$) controlling for shyness, see Figure 1. Chi-square difference tests revealed no moderating effect of sex on any of direct associations. The final model constrained all the paths to be equal between boys and girls. Model fit for the final model was good, $\chi^2(51) = 54.15$, $p = .36$, CFI = .99, RMSEA = 0.01 with $CI_{95\%}$ from .00 to .03, and SRMR = 0.02. R^2 for the latent factor of academic skills was 0.31, meaning that 31% of the variance in academic skills was explained by the model. Due to the partial scalar invariance found in the shyness latent variable, the means could not be interpreted. Group means on the inhibitory control latent variable indicated that girls were rated as better regulated than boys with a mean difference of .24 ($SE = .04$, $p < .001$).

Discussion

The current study is one of the first to examine SPS skills as a mechanism through which temperament influences children's academic achievement. Specifically, we sought to examine the direct and indirect effects of shyness and inhibitory control on academic skills. Results indicated that the effect of shyness on academic skills was mediated through SPS competence when controlling for inhibitory control, suggesting that the nature and quality of shy children's social interactions in the classroom influence their academic skills. Furthermore, the association between inhibitory control and academic skills was mediated through SPS competence controlling for shyness, suggesting the importance of studying the unique contributions of both reactive and self-regulatory aspects of temperament (Eisenberg et al., 1997).

Parent and childcare provider report of shyness in preschool was negatively related to child self-report of SPS competence, consistent with other studies demonstrating that shy children display less competent strategies during social problem situations (Moas & Henderson, 2009; Rubin & Borwick, 1984; Rubin, Daniels-Bierness, & Bream, 1984; Stewart and Rubin, 1995). This negative relation is likely due to the experience of fear, inhibition, and distress experienced by shy children during novel and challenging social situations with peers (Crozier, 2000; Fox et al., 2005; Kagan & Saudino, 2001). On the other hand, preschool shyness was unrelated to academic skills in early elementary school. Prior studies have reported mixed findings regarding the association between shyness and academic achievement. For example, shyness and reticent behavior early in kindergarten is negatively associated with achievement at the end of kindergarten (Coplan et al., 2001; Valiente et al., 2010), yet Asendorf and van Aken (1999) found no relation in early elementary school, although, a negative relation emerged and increased over the elementary school years.

Perhaps global measures of achievement limited our ability to detect individual differences in shy children's performance. For example, shyness is not related to overall language ability but is specifically related to certain aspects of language (e.g., vocabulary; Spere & Evans, 2009). Therefore, future studies should examine concurrent and longitudinal associations between shyness and specific aspects of language, math, and science achievement from preschool through the school years.

There was, however, an indirect effect of shyness on academic achievement through preschool SPS competence. These results indicate that developing SPS competence may be an important mechanism through which temperament relates to later academic adjustment. It is possible that fear and anxiety associated with novel and challenging social interactions, such as those experienced in the classroom, interferes with shy children's ability to execute competent social behaviors, leading to social withdrawal and fewer opportunities for shy children to interact with, and learn from, others (Rubin & Rose-Krasnor, 1992). In fact, various studies have found that shy children speak less upon arrival to school, during large-group teacher-guided activities, and spend more time in solitary passive play (Asendorpf, 1991; Asendorpf & Meier, 1993; Rimm-Kaufman & Kagan, 2005). This lack of experience in the social domain together with increased academic demands in early elementary school could lead to a cycle of negative social and behavioral adjustment in the classroom (Evans, 2001; Rubin & Rose-Krasnor, 1992), and may be responsible for the growing achievement gap between shy and resilient children over time (Asendorpf & van Aken, 1999).

Consistent with prior literature (Blair & Razza, 2007; Ciairano et al., 2007; Clark et al., 2010; Rhoades et al., 2009; Rudasill & Konold, 2008), inhibitory control was positively associated with both SPS competence and academic skills. The ability to inhibit a dominant behavior over a subordinate behavior is an important skill for both competent peer interactions and academic learning. For example, children must inhibit their desire to gain immediate possession of an exciting toy in favor of sharing and turn-taking during peer play. These behaviors would allow them to remain in positive contact with their peers, play with the toy, and avoid conflict. Inhibitory control also helps children follow teacher directions in school, remain on-task, refrain from disrupting others, and focus on learning tasks in the classroom, which are critical skills for academic success. Lin, Lawrence, and Gorrell (2003) analyzed 3,305 kindergarten teacher responses to a questionnaire collected as part of the Early Childhood Longitudinal Study – Kindergarten cohort. Teachers believe that preparing children for the social demands of the classroom are more critical for school readiness than developing academic skills (Lin, Lawrence, & Gorrell, 2003). Specifically, teachers reported that children's abilities to tell their wants and thoughts, follow directions, avoid being disruptive, take turns, and share are important school readiness skills. Therefore, the behaviors associated with inhibitory control and competent SPS behaviors in the classroom are necessary skills for children's academic success.

Children's ability to competently solve social problems in the classroom was found to be a mechanism through which inhibitory control related to academic skills, consistent with hypotheses and results described by Valiente et al. (2008, 2011). Interestingly, the teacher-child relationship, social functioning, and classroom participation mediate the association between effortful control and academic outcomes (Valiente et al., 2008, 2011). Taken together, current and prior findings provide evidence for the importance of social interaction in the classroom with both peers and adults, which appear to be crucial for academic development. Eisenberg, Valiente, and Eggum (2010) note in their review paper that while few studies have actually examined mediation, there is some evidence that effortful control is indirectly related to academic success through social functioning in school. Learning to competently interact with peers and adults in the classroom allows children to engage in classroom activities, receive support and positive feedback from peers and teachers, and

receive higher quality instruction, therefore social behavior in the classroom is an important mechanism through which academic achievement could be improved (see Eisenberg, Valiente, & Eggum, 2010 for a review).

Girls were rated higher than boys on maternal report of shyness, maternal and teacher report of inhibitory control, SPS competence, language and math skills in kindergarten, and language in first grade. On the other hand, sex did not moderate the relations among the constructs. These findings suggest that while mean differences exist between boys and girls, the mechanisms responsible for the associations between temperament and academic achievement are comparable for boys and girls. Consistent with these findings, reticent behavior is negatively related to social and academic competence, regardless of gender and using multiple informants (Coplan et al., 2001). In regard to inhibitory control, sex does not appear to moderate the relation between effortful control and social competence (Dennis, Brotman, Huang, & Kiely Gouley, 2007) or the indirect effects of effortful control on academic achievement through social functioning or school liking (Valiente et al., 2007; Valiente et al., 2011). Inconsistent with these findings, Coplan et al. (2004) found that shyness was only associated with teachers' perceptions of peer exclusion for boys, suggesting that shyness may pose more risk for boys than girls. However, the authors point out that one possible explanation for these findings is that teachers may be biased by children's shyness, perhaps perceiving shyness as more negative for boy's peer interactions than girls. Although more research is needed to replicate these results, it appears that sex does not moderate the relations between temperament, social competence, and academic outcomes. These findings imply that intervention programs designed to improve children's SPS skills should be targeted to both boys and girls.

Results of the current study provide empirical evidence for the importance of promoting SPS competence, particularly for temperamentally extreme boys and girls. Curricula should be introduced into the preschool classroom to teach children how to solve problem situations and, in turn, improve academic skills. For example, one study found that an SPS curriculum program, implemented in kindergarten and first grade classrooms, helped decrease aggression, promoted communication, and skills learned in the program were used by children during SPS situations outside of the classroom (Heydenberk & Heydenberk, 2007). Furthermore, prevention programs may extend to the home, as including a parenting component to an SPS intervention may further improve child behaviors, parent involvement in school, and the parent-child relationship (Reid, Webster-Stratton, & Hammond, 2007).

Limitation and Future Directions

It is important to note that the interpretation of results of the current study were limited by the fact that children with missing data differed from children included in the current study on some demographic variables. Therefore, although the sample was representative of the original sample in relation to temperament, the sample reported here is not nationally representative and results should be replicated in more diverse samples. In addition, temperamental shyness and inhibitory control were assessed based on maternal and childcare provider report data. While the inclusion of two informants for the temperament data likely improves the reliability and validity of the measurements, future studies should also consider behavioral observations to reduce potential confounds due to reporter bias.

We found evidence for the influence of temperament and SPS competency on academic outcomes; however, children's social outcomes in the classroom are also important and in need of more research attention. Temperamentally shy and dysregulated children are at-risk for peer victimization, loneliness, poor social competence, and poor friendship quality (Mendez, Fantuzzo, & Cicchetti, 2002; Rubin, Chen, McDougall, Bowker, & McKinnon, 1995; Rubin, Wojslawowicz, Rose-Krasnor, Booth-LaForce, & Burgess, 2006). Therefore,

future studies should also focus on the mechanisms responsible for the relations between temperament and social adjustment in school.

In the current study, temperament and SPS behaviors were measured concurrently. While there is theoretical and empirical evidence for including shyness and inhibitory control as predictors of SPS (Moas & Henderson, 2009; Rothbart & Bates, 2006), future studies should separate the measurement of these constructs over time. Furthermore, SPS was measured in the current study using a hypothetical reflective measure. Future studies should conduct SPS observations with peers, in order to better understand how shy and dysregulated children's actual SPS behaviors may differ. Moreover, various socialization factors influencing children's SPS behaviors should also be considered. Future studies should consider how parents and teachers teach young children to handle problem social situations and whether temperament influences the types and quality of these socialization processes in order to fully understand children's social and academic experiences.

Another limitation is the use of a single measure of self-regulation (i.e., inhibitory control) and the global measure of language and math skills. Self-regulation is composed of various dimensions (e.g., emotion regulation, attentional control, behavioral regulation; Eisenberg et al., 1997; McClelland, Cameron, Wanless, & Murray, 2007; Rueda, Posner, & Rothbart, 2004). Future studies should examine the unique and combined effects of various dimensions of self-regulation on SPS behavior and academic achievement. Future studies should also examine the influence of shyness and self-regulation on specific domains of academic achievement. That is, there is evidence that shyness is only related to specific aspects of language ability (Spere & Evans, 2009); however, little is known about the influence of shyness to specific components of math and science achievement. Future studies may also consider the influence of other dimensions of temperamental reactivity (e.g., anger, activity level) and social withdrawal (i.e., social disinterest) on children's SPS and academic achievement.

Conclusion

In summary, temperament is an important predictor of children's social and academic experiences. These relations are mediated in part through the effects of developing SPS competencies for both boys and girls, suggesting that children's social interactions and relationships in school are essential aspects of their academic and social functioning. Findings may inform preventative efforts targeted at temperamentally extreme boys and girls to aid in the development of socially competent behaviors in the classroom and subsequently prevent academic adjustment problems.

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Note: MR = Maternal Report; CR = Childcare provider Report; IC = Inhibitory Control; SPS = Social problem solving; Lang = Language; K = Kindergarten; G1 = First Grade

Figure 1.

The figure presents unstandardized path coefficients with standard error in parentheses. Indicator loadings are also unstandardized. The kindergarten language indicator was free to vary and thus displays the loading for boys and in parentheses, the loading for girls. All paths are significant at $p < .001$ except the direct path from shyness to academic skills, which was not significant. R^2 for the latent factor of academic skills was 0.31.

Table 1

Correlations Between Continuous Predictors and Outcomes, Means, and Variances.

	MR Shyness	CR Shyness	MR IC	TR IC	SPS Comp	Language K	Math K	Language G1	Math G1
CR Shyness	.42**								
MR IC	.06*	.12**							
CR IC	.15**	.09*	.37**						
SPS Competence	-.08**	-.14**	.13**	.07					
Language K	.04	-.01	.26**	.22**	.19**				
Math K	.04	-.01	.22**	.20**	.21**	.84**			
Language G1	-.02	-.01	.20**	.22**	.17**	.50**	.46**		
Math G1	.01	.02	.17**	.19**	.13**	.41**	.40**	.78**	
Mean	3.52	3.45	4.66	5.07	0.00	3.00	3.00	3.34	3.20
SD	1.10	1.27	.78	1.05	2.40	.98	.93	.96	.95
Range	1.0-6.6	1.0-6.9	2.0-6.7	1.7-7.0	-6.7-5.5	1-5	1-5	1-5	1-5

Note: MR = Maternal Report; CR = Childcare provider Report; IC = Inhibitory Control; SPS Comp= Social problem solving competence; K = Kindergarten; G1 = First Grade; SD = Standard Deviation

* $p < .05$;

** $p < .01$

Table 2

Descriptive Statistics for Sex Differences on Predictor and Outcome Variables.

	M	SD	t	n
MR Shyness				
Boys	3.44	1.10	-2.32 *	528
Girls	3.60	1.09		526
CR Shyness				
Boys	3.48	1.26	0.70	361
Girls	3.42	1.29		393
MR Inhibitory Control				
Boys	4.54	0.77	-5.32 **	532
Girls	4.79	0.76		529
CR Inhibitory Control				
Boys	4.92	1.09	-3.82 **	386
Girls	5.21	0.99		409
SPS Competence				
Boys	-0.34	2.44	-4.65 **	524
Girls	0.34	2.32		526
Language K				
Boys	2.82	0.96	-6.08 **	508
Girls	3.19	0.96		485
Math K				
Boys	2.90	0.97	-3.74 **	507
Girls	3.12	0.88		483
Language G1				
Boys	3.25	0.96	-3.16 **	501
Girls	3.44	0.94		504
Math G1				
Boys	3.22	0.95	0.69	500
Girls	3.18	0.95		503

Note: MR = Maternal Report; CR = Childcare provider Report; SPS = Social problem solving; K = Kindergarten; G1 = First Grade

*
 $p < .05$;

**
 $p < .01$