ASSOCIATIONS BETWEEN NATURALISTIC OBSERVATIONS OF TEMPERAMENT TRAITS, SOCIAL BEHAVIOR, AND FRIENDSHIP TIES IN A PRESCHOOL SETTING

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ABSTRACT

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A growing literature has focused on preschool as an important time for children's emotional and social development. The ways in which preschoolers engage in social behaviors and their temperament traits are expressed may vary across the school year, but these associations have traditionally been explored through parent or teacher report. Few studies have utilized a short-term longitudinal, observational approach to understand how these constructs function uniquely and how they intersect. The current study seeks to examine how temperament traits and social behavior manifest and relate to one another in a classroom setting as well as over time, while also examining the role of age and sex. Fifty-three children were observed in play and instruction situations in their university-affiliated preschool classroom, where teams of coders rated children's temperament traits and social interactions over the course of one school year. Children's interaction partners were also recorded to determine friendship ties between children. Results confirmed a three-factor higher-order temperament trait structure found in past literature and found relations among temperament traits, social behavior, age, and sex. Lending support for preschool effectiveness, effortful control rose steadily across the school year in both classrooms. In addition, temperament traits were able to predict subsequent social behaviors more often than social behaviors predicted subsequent temperament traits, indicating a reciprocal influence but emphasizing the importance of children's traits.

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INTRODUCTION

In modern research, temperament generally refers to individual differences in children's behavioral styles that are present early in life, are at least somewhat biologically based, and are stable across situations (Goldsmith et al., 1987; Sanson, Hemphill, & Smart, 2004; Shiner et al., 2012). Although there have been many diverse approaches to defining temperament traits, most major theoretical traditions agree that they are heritable and have biological substrates while still maintaining the critical influence of environmental and situational factors. Consensus is emerging to suggest that these temperament traits can be captured by a broad structure of three higher-order traits, including negative emotionality, positive emotionality, and effortful control (Ahadi & Rothbart, 1994; Shiner & Caspi, 2003). Negative emotionality generally includes sadness, anger, anxiety, discomfort, fear, and/or general distress (Rothbart & Bates, 2006). Positive emotionality/surgency is frequently seen as synonymous with extraversion, and includes smiling, laughing, activity, approach tendencies, and/or sociability (Gartstein & Rothbart, 2003); children high in positive emotionality tend to be more engaged with their environment (Lonigan, Phillips, & Hooe, 2003). Finally, effortful control generally refers to a child's self-regulation, involving both automatic and intentional processes, centered on response inhibition, attention, emotion regulation, and persistence at tasks (e.g., Kochanska & Knaack, 2003; Kochanska, Murray, & Harlan, 2000). While positive and negative emotionality are traditionally orthogonal constructs (e.g., Clark & Watson, 1991; Durbin, Klein, Hayden, Buckley, & Moerk, 2005), effortful control correlates modestly to moderately with each of these traits. Some research has found that children with high levels of both positive emotionality and effortful control have better peer relationships and academic outcomes, while children with high levels of negative emotionality and low levels of effortful control have the lowest levels of social

skills and more behavior problems (e.g., Acar, Rudasill, Molfese, Torquati, & Prokasky, 2015; Eisenberg, Fabes, Bernzweig, Karbon, Poulon, & Hanish, 1993; Fernandez-Vilar & Carranza, 2013; Sanson et al., 2004).

Because temperament traits exist within the larger environmental framework (e.g., sociocultural contexts, parent and family characteristics, etc.), temperament traits have been thought to interact with environmental and social factors to predict developmental outcomes and adjustment (Fox, Henderson, Perez-Edgar, & White, 2008; Sanson et al., 2004). Although temperament traits are frequently treated as the predictor variables and children's social behaviors are treated as the outcome variables, this predictor-outcome relationship is frequently blurry (Sanson et al., 2004). That is, this relationship may not be strictly unidirectional, and social behaviors may influence children's temperament traits. For example, children trapped in patterns of aggression with other children might demonstrate consistently higher levels of negative emotionality than children who find themselves well-liked and accepted by peers. Children who have more success in social interactions or engage in social interactions more frequently obtain more practice learning how to effectively interact with others, perhaps shaping their subsequent trait displays.

Preschool peer interactions are critical for a number of reasons, as they provide many children with their first opportunity to spend considerable time with peers outside of their home environment. These early experiences in peer socialization (e.g., Blair, Denham, Kochanoff, & Whipple, 2004) are important to practice before formal schooling; social competence upon entering kindergarten predicts both academic and social outcomes, such as school readiness, positive attitudes toward school, and quality of relationships with teachers and peers (Carlton & Winsler, 1999; Ladd, Birch, & Buhs, 1999). Successful peer interactions as rated by teachers

have been associated with more adaptive social and behavioral development (Coolahan, Fantuzzo, Mendez, & McDermott, 2000; Fantuzzo, Sekino, & Cohen, 2004), whereas interactions characterized by conflict are associated with less adaptive emotional and behavioral outcomes, including trouble adjusting to school (Ladd, Kochenderfer, & Coleman, 1996) and psychiatric disorders (Welsh, Bierman, & Pope, 2000). Peer play is the main channel through which preschoolers interact with one another socially, and successful interactions mark an important developmental milestone.

Little research, however, has been done to examine how temperament traits relate to the types and frequencies of interactions that preschool children engage in with one another and their teachers. Given that children's temperament traits have been related to success in early school settings even after controlling for intelligence (e.g., Lerner, Lerner, & Zabski, 1985; Schoen & Nagle, 1994), the connections between these temperament traits and types of interactions in which children engage are important to explore in a school setting. Navigating one's own emotions in emotion-laden interactions is a different challenge for each child, and may relate differently to social domains. Children with higher negative emotionality frequently have lower social competence (Coplan, Bowker, & Cooper, 2003), while effortful control positively predicts peer relations over time (Valiente et al., 2003). Other findings have indicated that a combination of lower-order temperament traits including high activity, low persistence, and negative emotionality combine to predict peer rejection (Walker, Berthelsen, & Irving, 2001). However, most research on connections between temperament traits and social relationships have relied on questionnaire methods to assess one or both of the constructs. While these methods provide important insights into children's behaviors and development, they are subject to informant

biases and do not provide objective, standardized evaluation of children's functioning.

Contributions of Child Sex and Age

A good deal of investigation has explored sex differences in temperament traits, although mostly via questionnaire measures. A meta-analysis by Else-Quest, Hyde, Goldsmith, and Van Hulle (2006) examined sex differences in temperament traits from ages 3 through 13. Effortful control demonstrated the largest sex difference (d=1.01), with girls displaying higher effortful control than boys. In addition, boys had higher levels of positive emotionality/surgency, while there were few differences between boys and girls in negative emotionality. However, this meta-analysis was based almost entirely on questionnaire data; only 3.6% of the contributing effect sizes stemmed from behavioral observations and laboratory measures. Olino, Durbin, Klein, Hayden, and Dyson (2013) found that girls were higher in sociability (a subtrait of positive emotionality) and lower in negative emotionality and impulsivity, but only when assessed through laboratory measures. This laboratory finding was in direct contrast to maternal reports in the same study, which indicated that girls had higher negative emotionality than boys, as well as paternal report, which indicated that girls had lower levels of sociability than boys. The present study will add to the literature by examining sex differences through naturalistic observation.

Sex differences are also evident in social behavior in childhood (Berenbaum, Martin, & Ruble, 2008; Ruble, Martin, & Berenbaum, 2006). Through both direct and indirect pathways, sex differences have strong ties to social interactions, with children selecting same-sex playmates as well as playmates who engage in gender-stereotyped behavior at similar rates (Kornienko et al., 2013). An influential study by Martin and Fabes (2001) found that the vast majority of boys and girls spend more time with same-sex peers than with other-sex peers, and that same-sex play but not mixed-sex play predicted changes in aggression and activity levels. Specifically, boys

who spent more time with other boys in the fall semester demonstrated increases in aggression and activity levels in the spring semester, while girls who spent more time with other girls in the fall semester showed decreases in aggression and activity levels in the spring semester. While preschool boys have been shown to prefer bikes, balls, and blocks, girls have been shown to prefer dolls, art, and dress-up games (Ruble et al., 2006). Since children tend to play with gender-stereotypical toys most often when engaged in solitary play (Ruble et al., 2006), social behaviors provide avenues to explore a greater range of activities and experiences (Goble, Martin, Hanish, & Fabes, 2012). Therefore, playing in same-sex groups may increase sex-stereotyped behavior, while opposite-sex play may decrease this behavior or increase the probability of engaging in play typical of the opposite sex.

In a study examining temporal dynamics in social interactions, girls' (but not boys') observed positive affect was dependent on immediately prior displays of positive affect from an unfamiliar same-sex peer (Beltz, Beekman, Molenaar, & Buss, 2013). In the same study, researchers also found that boys' (but not girls') activity levels were dependent on an unfamiliar same-sex peer's current (not prior) activity level, demonstrating the different ways children might respond to one another based on sex. In addition, while girls are more likely to identify their closest friends as those who have lower teacher-rated activity levels, boys tend to identify their closest friends as those who have higher teacher-rated activity levels (Gleason, Gower, Hohmann, & Gleason, 2005). Temperament might predict social behaviors in different ways for boys as compared to girls; Blair et al. (2004) found that higher effortful control predicted social competence for boys, but not for girls, leading to questions about the differing roles of temperament traits by sex. Less research has been done on sex differences in specific types of

social behavior, and examining how children's sex relates to the frequency of engaging in these behaviors will allow us to determine which behaviors tend to be more sex-dependent.

Temperament traits may also change in their mean levels over development, even within the relatively short preschool period. Most studies addressing age differences cover a larger span of time (e.g., Newman, Caspi, Moffitt, & Silva, 1997) rather than focusing on changes within the two- to three-year preschool context. However, the expression of temperament traits, particularly with respect to handling new peer and educational expectations, may change even over relatively brief periods. In a laboratory task, 4-year-olds demonstrated less avoidance of new peers than 3-year-olds and were also rated higher on inclinations to approach unfamiliar others (Stansbury & Harris, 2000). In a classroom setting, similar results were found, where older preschoolers were more likely to engage in social interactions and display initiative than younger preschoolers (Mendez, McDermott, & Fantuzzo, 2002). These different social interaction patterns may also relate to preschoolers' friendship choices, as Gleason et al. (2005) found preliminary evidence that older preschoolers were more likely to consider peers' temperament traits when forming bonds, whereas younger preschoolers' friendship choices were based on sex alone. However, not all examinations of age in preschoolers' social development have found effects; Schaefer, Light, Fabes, Hanish, and Martin (2010) found that age did not relate to preschoolers' social network formations. To address important gaps in understanding how temperament traits and social behavior may change by age in a naturalistic setting, the present study will analyze behavioral observations for age differences.

The Role of Friendship Ties

In assessing children's friendships and relationships with peers in classroom settings, researchers have largely relied on sociometric ratings to gain a sense of who interacts most often

with whom. Frequently, children are asked to name or point to pictures of their closest friends, and studies often use different methods for collecting such data, including whether to constrain the number of friends identified as well as whether a friendship must be reciprocal to exist (i.e., both friends must independently nominate the other to count a friendship). Children are also sometimes asked to provide information on the friendships of other students in the classroom (e.g., "Who does Bobby like to play with?"), and if these friendship groups are acknowledged by a certain percentage of children, researchers assume these groups exist (as discussed in Gifford-Smith & Brownell, 2003).

However, very few studies have observationally assessed children's friendship ties (for notable exceptions, see Hanish, Martin, Fabes, Leonard, & Herzog, 2005, as well as Schaefer et al., 2010). During free play periods in a preschool classroom, children have the autonomy to choose the peers with whom they interact. While two children may interact in social games and behaviors an equal amount of time, for one child, these games may all take place with two or three other children, while for the second child, these games might take place a few times over a larger sample of children. While both children in this instance are equally sociable and engage in the same amount of social behaviors, the latter child has more friendship ties and is considered to be a more central figure in the classroom. In the present study, friendship ties are calculated when children interact with one another more than would be predicted from their overall engagement in social behaviors. By gathering these ties through behavioral data, more flexibility exists with respect to how many friendships a child can have, as opposed to sociometric nominations, where one child's third-best nominated friend may be a distant acquaintance while another child's third-best nominated friend may be a constant playmate.

The Current Study

The present study seeks to examine the connection between preschool children's observed social interactions and observed temperament traits. Children were observed in naturally-occurring play and instruction situations in their preschool classroom. Different teams of coders rated children's temperament traits and their social interactions. We were guided by several goals, including to better understand how temperament traits and social behavior are manifested and related to one another in the preschool classroom, how they relate over time, and how social behavior and friendship ties among children are related to their age and sex.

Based on the laboratory studies of Olino et al. (2013) and the meta-analysis of Else-Quest et al. (2006), we predicted that boys would have higher levels of negative and positive emotionality and lower levels of effortful control than girls. We also hypothesized that higher positive emotionality as well as higher effortful control would be related to more social play with peers, while higher levels of positive emotionality would be related to more friendships. We predicted that older children would display higher levels of effortful control than the younger children, and that effortful control would change across the year to reflect the time children have spent in an academic environment. We anticipated that children would spend more time alone in the beginning of the year, but this time would lessen as the year progressed and children engaged more with social others. Furthermore, we theorized that change in temperament traits and social behaviors would be reciprocally influential in the classroom, in that children's temperament traits would affect subsequent social behavior and also vice versa.

METHOD

Participants and Procedure

Participants were 53 children (29 boys and 24 girls) enrolled in two age-based classrooms (3-year-olds and 4-5-year-olds) in a Midwestern university daycare facility. In the younger class, children's mean age was 41.74 months (*SD* = 4.38, range = 33–47 months) at the beginning of the school year, while in the older class, children's mean age was 52.81 months (*SD* = 3.63, range = 45–59 months). The majority of children were identified by their parents as White (*n*=27, 50.9%), with the remainder identified as Black (*n*=3, 5.7%), Asian (*n*=4, 7.5%), mixed-race or other race (*n*=8, 15.1%), or parents declined to answer (*n*=11, 20.8%). Forty-eight children were present over the course of both semesters, while one child was present for only the fall semester and four children were present for only the spring semester. In the fall semester, 40.8% (*n*=20) of children attended school full-time and 59.2% (*n*=29) attended school half-time (either in the morning or in the afternoon), while in the spring semester, 36.5% (*n*=19) attended school full-time and 63.5% (*n*=33) attended half-time. Only one child changed attendance status over the course of the year (from full day to half-day). Two children were excluded in all analyses due to being present for fewer than five observational periods.

Children were observed over the course of two consecutive semesters through "scan" observations (Fabes, Shepard, Guthrie, & Martin, 1997; Hanish et al., 2005; Mize & Ladd, 1988; Pellegrini, Blatchford, Kato, & Baines, 2004). Undergraduate research assistants observed each child for a certain period of time, rotating through a randomly ordered class list. While one group of Ras coded social behaviors, the other group coded temperament traits. Scans lasted 10 s for social behavior and one min for temperament trait ratings. These observations happened most days school was in session from August to May of one complete school year.

For social behavior, a total of 15,433 observations were collected over the course of the school year, with an average of 291.19 observations per child (*SD* = 122.07, range = 84–507). For temperament traits, a total of 11,408 observations were collected over the course of the school year, with an average of 215.25 observations per child (*SD*=96.53, range = 54–403). Differences in number of observations were largely due to full-day or half-day daycare attendance status of the child as well as attendance in only part of the school year. Reliabilities were calculated by assigning two Ras to watch the same child at the same time. For social behavior, 1,088 observations (7.05%) were double-coded. Social behaviors were collapsed across category and examined for agreement between the two coders (agreement was coded if the two coders categorized the child in the same social behavior, while disagreement was coded if the two coders categorized the child in a different social behavior). Across coders, 70.48% agreement was reached in the fall semester and 73.92% agreement in the spring semester.

Coding Children's Social Behavior

Based on the procedures of Martin and Fabes (2001) and Hanish et al. (2005), the observer gathered information about the target child from the 10 s scan about the presence of adults, the context, and the type of play. First, observers coded whether or not there was a teacher or other adult in the vicinity or outside the vicinity but whose attention was clearly directed toward the child. Second, observers assessed the context, determining whether the child was in a structured large group (e.g., circle time), a structured small group (e.g., designated snack time at several smaller tables), a semi-structured situation (e.g., child must choose one of three or four different activities), free-play (i.e., the child could freely decide what to play with, where, and with whomever they pleased), or a transition period (e.g., children are putting on winter clothes to go outside).

Next, observers indicated the dominant behavior of the target child during the 10 s observation (that is, only one behavior coded). These included solitary and constructive play (playing alone in a situation where the child is creating or constructing, such as putting a puzzle together or playing with blocks), solitary and nonconstructive play (playing alone in a situation where the child is engaging in repetitive or dramatic play, such as bouncing a ball or "make believe"), unoccupied play (playing alone with a lack of focus or intent, such as staring off into space or walking around aimlessly), teacher-oriented behavior (child is involved in some interaction with the teacher with no peer interaction), onlooking behavior (child is watching other children play but is not involved), parallel play (child is playing alongside peers in the same activity but not interacting with them), rough/tumble play (child is engaged in physical action towards others in a playful or happy way, such as wrestling for fun), and social play (child is involved in an activity with 1 or more children).

When the target child was involved with others in the classroom (through onlooking, parallel play, rough/tumble play, or social play), the identities of those peers was recorded. In the current study, we focused on the identities of other children specifically when the target child was involved in social play. To calculate children's social ties, a regression equation was created for each dyad that included the total number of times each child was observed as well as the total number of each child was observed in social play (to control for child's level of sociability). From this regression equation, we got the total number of times these two children would be predicted to interact; if the two children interacted more than was predicted, they were considered to have a social tie. Children with more social ties were considered to be more central in the classroom. Mathematically, we can represent the regression model

$$y_{ij} = \beta_0 + \beta_1 x_i + \beta_1 x_j + \beta_2 x_i + \beta_2 x_j + \varepsilon_{ij}$$

where y_{ij} is the observed number of times in social play between child I and child j. β_0 is the intercept term, and ε_{ij} is the error term. $\beta_1\chi_i$ indicates the total number of times child I was observed, while $\beta_1\chi_j$ indicates the total number of times child j was observed. $B_2\chi_i$ indicates the number of times child I was observed in social play, while $\beta_1\chi_j$ indicates the number of times child j was observed in social play.

Coding Children's Temperament Traits

Temperament trait coding was based on a global coding system previously validated by our group for rating individual differences in traits observed in a laboratory setting (see Durbin, Hayden, Klein, & Olino, 2007; as well as Durbin et al., 2005). Following each 1 min scan, the target child was rated on temperament traits including engagement, activity level, anticipatory positive affect, initiative, sociability, compliance, attentional control, and impulsivity. A 4-point Likert scale was used to assess these traits, with 0 = *very low*, 1 = *low to moderate*, 2 = *moderate to high*, and 3 = *very high*. Affective traits, including positive affect, sadness, anger, and fear were rated on a 5-point Likert scale based on the presence of facial, vocal, and bodily emotional expressions, with 0 = *this affect not displayed*, 1 = *1–2 fleeting instances*, 2 = *1–2 moderate instances*, 3 = *several moderate instances*, 4 = *2–4 high intensity instances, or sustained moderate intensity*, and 5 = *more than 5 high intensity instances, or sustained high intensity.*

In coding affect, raters were instructed not to make inferences regarding the child's subjective emotional state but instead on their observable emotional expressions. Engagement was judged based on how interested the target child was in his/her task. Activity was assessed via the child's level and speed of movement. Anticipatory positive affect was determined by the child's positive affect in clear anticipation of an event that had not yet occurred. Initiative was based on the child's assertiveness in their interpersonal interactions. Sociability was assessed by

the child's attempts to engage with peers and adults as well as the amount of energy and affiliation invested in social interactions. Compliance was judged from the child's willingness to follow the instructions of teachers (not peers). Attentional control included both maintaining attention on a task as well as appropriately shifting attention based on environmental demands. Finally, impulsivity was determined by the child's lack of hesitation or behavioral control.

To better capture rare behaviors, the research assistants coding temperament traits were occasionally assigned to specifically watch for instances of negative affect by scanning the classroom to identify any child displaying negative affect and then code that child's behavior for the next minute. When no negative affect was occurring in the classroom after a five min scan, they would switch to normal temperament trait coding using randomized lists of children to code for each minute. However, if an instance of negative affect occurred from another child, the research assistant would switch their attention to the instance of negative affect and observe the other child for one min.

Trait ratings were averaged across all observations conducted across the school year. In previous laboratory settings, higher-order factors have emerged to include positive emotionality (positive affect, anticipatory positive affect, initiative, sociability, engagement), negative emotionality (sadness, fear, anger), and effortful control (compliance, attentional control, reverse-scored activity level, reverse-scored impulsivity). For the current study, the structure of higher-order factors was examined to determine if temperament traits assessed in a classroom setting had a similar structure to those assessed in a laboratory setting. These resulting composites were then used in all analyses.

Reliability of temperament ratings were computed on a subset of 907 observations for which two coders rated the same child. Intraclass correlation coefficients for the composites were as follows: positive emotionality (.65), negative emotionality (.78), and effortful control (.80).

RESULTS

Temperament Traits As Observed in the School Setting

The first goal of the current study was to examine children's temperament traits as observed over the course of the school year. To assess the structure of temperament traits, a principal components analysis of traits averaged across all observations was conducted, and the resulting composites were used in all subsequent analyses.

The underlying structure of temperament traits. First, the factorability of the lower-order temperament traits was examined. Nine of the 12 traits correlated at least .3 with at least one other trait, suggesting that factor analysis may be appropriate. Correlations between the lower-order traits can be found in Table 1. In addition, Bartlett's test of sphericity was significant, $\chi^2(66)=548.55$, $p<.001$, and the Kaiser-Meyer-Olkin measure of sampling adequacy was .70, which is above the recommended value of .6. In the anti-image correlation matrix, the diagonals for all traits except for fear were over .5. Finally, the communalities were all above .4, indicating the common variance of each trait with other traits. Therefore, all 12 lower-order temperament traits were entered into the factor analysis.

Because the primary purpose of the analysis was to identify composite higher-order temperament traits, principal components analysis (PCA) was performed, and since the resulting factors were presumed to be correlated, an oblimin rotation was used. The initial eigen values indicated that the first factor explained 37% of the variance, the second factor explained 26% of the variance, and the third factor explained 12% of the variance. This three factor solution, which cumulatively explained 76% of the variance, was in line with previous evidence suggesting a three-factor solution for temperament and mapped onto composite factors of positive emotionality, effortful control, and negative emotionality.

All traits except for fear had factor loading of at least .6 (fear had a factor loading of .4). Some traits had strong and nearly identical cross-loadings; in these cases, the traits were sorted based on theory and previous empirical findings (e.g., compliance was grouped with effortful control). The factor loading matrix is presented in Table 2.

Based on these loadings, composite scores were created by taking the mean of the traits in each factor. Positive emotionality included activity, sociability, impulsivity, positive affect, and anticipatory positive affect; effortful control included engagement, initiative, compliance, and attentional control; and negative emotionality included sadness, anger, and fear. Descriptive statistics including means, standard deviations, and ranges for both lower-order traits and their resulting composite factors can be found in Table 3. Higher scores on these factors indicated more intense displays of the traits. Since an oblimin rotation was used, which allowed composite factors to be correlated, associations among the resulting traits were examined. Although positive emotionality was not related to negative emotionality, effortful control was moderately positively related to both (with positive emotionality, $r(53)=.35$, $p=.01$; with negative emotionality, $r(53)=-.36$, $p=.01$).

The role of children's age, sex, classroom, and attendance status. We examined associations between the traits and children's age, sex, classroom, and attendance status to better understand correlates of children's traits as expressed in the classroom. Children's age in months was correlated with positive emotionality, $r(53)=.61$, $p<.001$, although age did not correlate with negative emotionality or effortful control. Next, we conducted an independent-samples *t*-test to determine if there were sex differences; this test indicated that boys ($M=.87$, $SD=.22$) expressed more positive emotionality than girls ($M=.76$, $SD=.22$), $t(51)=-2.26$, $p=.03$, $d=.50$, while boys and girls did not differ on negative emotionality or effortful control. The

difference between boys and girls on positive emotionality was maintained even after accounting for child age, partial η^2=.08, with a small-to-medium effect for both. However, after examining these findings separately for children who attended school for the full day as compared to children who attended school for half the day, boys' positive emotionality was only higher than girls' among children who attended school the full day (*M*=.95, *SD*=.16 for boys; *M*=.75, *SD*=.13 for girls; *F*(1,19)=7.31, *p*=.01, partial η^2=.28), not half the day (*M*=.85, *SD*=.24 for boys; *M*=.77, *SD*=.17 for girls). While we had hypothesized that boys' levels of positive emotionality would be higher than girls', the null findings for differences in effortful control and negative emotionality were unexpected and did not match prior findings (i.e., Else-Quest et al., 2006; Olino et al., 2013), perhaps due to the observational school context in the current study.

Next, independent-samples *t*-tests were conducted to determine if there were attendance status differences on the traits. While children did not differ on positive emotionality and effortful control by attendance status, children who attended the full day (*M*=.03, *SD*=.08) demonstrated higher levels of negative emotionality than children who attended for a half day (*M*=.01, *SD*=.01), *t*(51)=-3.18, *p*<.01, *d*=.35. When examining this result further by separating child sex, this effect was only observed for girls, *t*(22)=-3.22, *p*<.01, *d*=1.20. That is, girls who attended for the full school day demonstrated more negative emotionality than girls who attended school for half days, while boys did not differ on negative emotionality based on attendance status. We also looked at attendance status in terms of morning-only compared to afternoon-only children and found higher levels of effortful control in children who attended school only in the afternoon (*M*=2.03, *SD*=.16) than in children who attended only in the morning (*M*=1.74, *SD*=.09), *t*(29)=-6.03, *p*<.001. No attendance status differences were found for positive or negative emotionality.

Finally, 2(classroom: younger, older) x 2(sex: male, female) between-subjects ANOVAs that controlled for age were conducted on the three temperament traits to determine if there were particular classroom effects not accounted for by child age. Results indicated no main effects of classroom status (younger versus older classroom).

Temporal change in temperament traits. Positive emotionality, negative emotionality, and effortful control were grouped by semester, and then split into four "waves." Wave 1 consisted of the average temperament traits from the first half of the fall semester (August to October), while Wave 2 consisted of the averages derived from the second half of the fall semester (November and December). Wave 3 was made up of the first half of the spring semester (January and February), while Wave 4 was the second half of the spring semester (March to June). Means, standard deviations, and ranges for the temperament traits split by wave can be found in Table 4.

First, for each temperament trait, omnibus three-way ANOVAs were conducted for change over time (wave: 1, 2, 3, 4), child sex (male, female), and classroom (younger, older). Since children's age in months was significantly correlated with positive emotionality, age was added as a covariate for that model. Significant main effects of wave as well as significant interactions between wave and classroom or wave and sex were followed up with their own analyses. While no significant within-subjects effects were found through this omnibus test for positive or negative emotionality, effortful control demonstrated a significant main effect of wave. A repeated-measures ANOVA of wave was conducted, $F(3,135)=73.72$, $p<.001$, partial $\eta^2=.62$. A post-hoc LSD test indicated that levels of effortful control rose steadily across the year, with wave 4 ($M=2.02$, $SD=.19$) and wave 3 ($M=1.88$, $SD=.20$) significantly higher than each prior wave, $p<.05$, although wave 2 ($M=1.73$, $SD=.15$) was not significantly higher than

wave 1 (*M*=1.68, *SD*=.14). For all children, effortful control was the only temperament trait to change across the year, in line with our hypothesis that time in an academic environment raises children's regulatory and attentional control; given that age was not correlated with effortful control, it appears that preschool works.

Social Behavior As Observed in the School Setting

The second goal of the current study was to examine children's social behaviors over the course of the year. For each observation interval, children were identified as engaging in solitary constructive play, solitary nonconstructive play, parallel play, rough-and-tumble play, onlooking, teacher-oriented behavior, social play, or unoccupied behavior. Due to few observations of rough and tumble play across the year, this behavior was dropped. Finally, with the exception of analyses testing for an underlying structure, all analyses were performed with the social behaviors transformed into proportions to account for differences in the number of times children were observed, primarily due to differences in the total number of observations available for children with full day versus half day attendance status. Proportions were calculated as the number of times each child was observed in that behavior divided by the total number of times that child was observed. Means and standard deviations of the social behavior proportions (from here on referred to as "social behaviors") can be found in Table 5.

The underlying structure of social behavior. Because of the non-independence between the social behavior ratings (i.e., children could only be in one social behavior per observation), a factor analysis could not be performed. Instead, correlations between the averages of these behaviors across observations as well as internal consistency metrics (alpha) resulting from various combinations of social behavior variables were examined for possible composites. Several zero-order correlations were found between social behaviors. Social play in

particular was related to most other behaviors, with negative relationships with both solitary constructive ($r(53)=-.51$, $p<.001$) and solitary nonconstructive ($r(53)=-.32$, $p=.02$) play. Social play also had significant negative relationships with unoccupied ($r(53)=-.47$, $p<.001$), onlooking ($r(53)=-.27$, $p=.05$), and teacher-oriented ($r(53)=-.27$, $p=.05$) behaviors. Teacher-oriented behaviors were likewise negatively correlated with unoccupied behaviors, $r(53)=-.32$, $p=.02$, and parallel play, $r(53)=-.40$, $p<.01$. Because of their moderate-to-strong correlation values, solitary constructive, solitary nonconstructive, and reverse-coded social play were combined. The resulting internal consistency was in the poor-to-acceptable range, $\alpha=.58$. Only social play correlated strongly with the composite scale, while the remaining factors demonstrated weaker correlations ($r=.25$-$.36$). Removing solitary nonconstructive play resulted in a .01 increase in scale consistency.

Next, we tested a scale of unoccupied behavior, parallel play, and reverse-coded teacher-oriented behavior. It had poor internal consistency, $\alpha=.49$, with unoccupied and parallel play correlating .22 and .24 with the total scale, respectively, while teacher-oriented behavior correlated .50 with the total scale. Overall, due to the lack of strong indication that these behaviors should be combined as well as the possibility that each social behavior factor may operate uniquely in the classroom, we opted to keep social behaviors separate in all analyses.

The role of children's age, sex, classroom, and attendance status. First, zero-order correlations between children's age in months and their social behaviors were examined. Results indicated that older children engaged in lower levels of unoccupied behaviors, $r(53)=-.34$, $p=.01$, and parallel play, $r(53)=-.36$, $p<.01$. Older children engaged in social play more often than younger children, $r(53)=.46$, $p=.001$. Next, independent-samples *t*-tests were conducted to determine if there were sex differences in social behaviors. Only unoccupied behaviors differed

significantly, $t(51)=2.51$, $p=.02$, $d=.88$, with girls ($M=.21$, $SD=.04$) engaging in unoccupied behaviors more often than boys ($M=.17$, $SD=.05$). These results remained the same after controlling for children's age in months. Children did not differ on their social behaviors based on their attendance status (full or half day), but the half-day children did differ based on morning-only or afternoon-only schedules. Children engaged in more unoccupied play when they attended only in the afternoon ($M=.23$, $SD=.06$) than only in the morning ($M=.16$, $SD=.16$), $t(29)=-3.87$, $p=.001$. In addition, children engaged in more teacher-oriented behavior when they attended only in the morning ($M=.30$, $SD=.06$) than only in the afternoon ($M=.24$, $SD=.05$), $t(29)=2.85$, $p<.01$. Lastly, 2(classroom: younger, older) x 2(sex: male, female) between-subjects ANOVAs were conducted on the seven social behaviors while controlling for age to examine classroom effects; aside from the main effect of child sex on occupied behavior, as noted above, no other significant main effects or interactions were found.

Temporal change in social behaviors. Next, changes in social behavior across the year were examined. Social behaviors were grouped into four waves as described above for temperament traits. See Table 6 for the means, standard deviations, and ranges split by wave for social behavior.

Omnibus three-way ANOVAs were conducted for each social behavior to examine change over time (wave: 1, 2, 3, 4) by child sex (male, female) and classroom (younger, older). As children's age in months was significantly correlated with unoccupied, parallel, and social play, age was added as a covariate for those models. Any significant main effects of wave as well as significant interactions between wave and classroom or wave and sex were followed up with their own analyses. No significant within-subjects effects were found through this omnibus test for unoccupied behavior or parallel play. However, solitary constructive play, solitary

nonconstructive play, teacher-oriented behavior, onlooking behavior, and social play did reveal significant change over time.

For solitary constructive play, the omnibus ANOVA test of within-subject effects revealed a significant interaction between wave and classroom, $F(3,126)=6.51$, $p<.001$. To disentangle this finding, classrooms were examined separately across waves; when the younger class was separated from the older class, only the older classroom demonstrated significant change over time, $F(3,69)=4.87$, $p<.05$, partial $\eta^2=.18$. Solitary constructive behaviors decreased from wave 1 ($M=.12$, $SD=.07$) to waves 2 ($M=.08$, $SD=.06$) and 3 ($M=.07$, $SD=.05$), but increased again at wave 4 ($M=.08$, $SD=.05$); a post hoc LSD test revealed that wave 1 was significantly higher than all other waves, $p<.05$.

For solitary nonconstructive play, the omnibus ANOVA test of within-subject effects demonstrated a significant main effect of wave, $F(3,126)=7.35$, $p<.001$. A repeated-measures ANOVA of wave was conducted, $F(3,135)=7.69$, $p<.001$, partial $\eta^2=.15$, and visual inspection revealed that solitary nonconstructive play decreased across the year. A post hoc LSD test indicated that wave 1 ($M=.09$, $SD=.05$) was significantly higher than waves 3 ($M=.06$, $SD=.04$) and 4 ($M=.06$, $SD=.06$), but not wave 2 ($M=.08$, $SD=.05$), $p<.05$. Wave 2 was also higher than waves 3 and 4, $p<.05$.

For teacher-oriented behavior, the omnibus ANOVA of within-subject effects indicated a significant interaction between wave and classroom that qualified a main effect of wave, $F(3,126)=12.75$, $p<.001$. When classrooms were examined separately with within-subject ANOVAs testing differences between waves, both the younger and older classrooms revealed significant changes over time but in different ways. Visual inspection indicated that the younger class engaged in more teacher-oriented behavior in the first half of each semester than the second

half, $F(3,63)=5.32$, $p=.002$, partial $\eta^2=.20$, while in the older classroom, teacher-oriented behavior was lower in the first semester and higher in the second semester, $F(3,69)=74.91$, $p<.001$, partial $\eta^2=.77$. A post hoc LSD test for the younger classroom revealed that wave 2 ($M=.22$, $SD=.06$) had significantly fewer teacher-oriented behaviors than wave 1 ($M=.28$, $SD=.07$), wave 3 ($M=.30$, $SD=.09$), or wave 4 ($M=.28$, $SD=.09$), $p<.05$; the decline from wave 3 to wave 4 did not reach significance. For the older classroom, a post hoc LSD test indicated that waves 3 ($M=.34$, $SD=.06$) and 4 ($M=.32$, $SD=.08$) had significantly more teacher-oriented behavior than waves 1 ($M=.20$, $SD=.05$) and 2 ($M=.19$, $SD=.05$), $p<.001$. In addition, wave 3 had significantly more teacher-oriented behavior than wave 4, $p<.05$.

In similar fashion to teacher-oriented behavior, the omnibus ANOVA of within-subject effects for onlooking behaviors revealed a significant interaction between wave and classroom that qualified a main effect of wave, $F(3,126)=3.43$, $p<.05$. When classrooms were examined separately, only the younger classroom demonstrated significant change over time, $F(3,63)=5.19$, $p<.01$, partial $\eta^2=.20$. A post hoc LSD test revealed that while onlooking behavior was steady over waves 1 ($M=.04$, $SD=.02$) and 2 ($M=.04$, $SD=.03$), there was a significant jump in wave 3 ($M=.05$, $SD=.04$) as compared to wave 2, $p<.01$. Wave 4, on the other hand, had significantly fewer onlooking behaviors than all previous waves ($M=.02$, $SD=.02$), $p<.01$.

Finally, for social play, the omnibus ANOVA test of within-subject effects revealed a significant interaction between wave and gender. Change over time was examined separately for boys and girls through within-subject ANOVAs. When age was included as a covariate, no significant differences were found in either ANOVA. When not covarying for age, results indicated that only boys differed significantly across the year, $F(3,72)=7.04$, $p=.001$, partial $\eta^2=.23$. Visual inspection indicated that boys' social play was higher in the second half of each

semester than in the first half, and higher in the first semester in general than in the second semester. A post hoc LSD test revealed that wave 3 (*M*=.20, *SD*=.10) had significantly fewer instances of social play than wave 1 (*M*=.26, *SD*=.09) or wave 2 (*M*=.29, *SD*=.13), while wave 2 had more instances of social play than wave 4 (*M*=.24, *SD*=.09).

Temporal changes in social behaviors are not independent of one another, as children who are spending less time in one type of social behavior are spending more time in another type. As hypothesized, children's time alone was higher in the beginning of the year than later in the year; however, while this was universally true for solitary nonconstructive play, only the older classroom decreased across the year on solitary constructive play. Although the older and younger classrooms did not differ significantly overall on time engaged in solitary constructive play, it is possible that spending time in solitary constructive play was differentially encouraged by classroom teacher and/or reflect developmental differences. Teacher-oriented behavior differences between the younger and older classroom lead to interesting questions about the ways in which children on average interact with adults; in the older classroom, children were engaged more with their teachers in the first semester than in the second semester, perhaps reflecting an assimilation process. However, in the younger classroom, the possible assimilation process looks somewhat different, with more teacher-oriented behavior in the first half of each semester than the second half. Perhaps children in the younger classroom require more attention after breaks (e.g., summer, winter) but then operate more independently in free-play periods. Interestingly, and contrary to our expectations, children's social play did not increase across the school year. When not taking age into account, boys' but not girls' social play demonstrated an interesting trend of rising in the second half of each semester, perhaps reflecting new tie formation or increased comfort with social others, while girls' social play was steady. Finally,

changes in onlooking behavior, which fluctuated only in the younger classroom in the spring semester, as well as the lack of change in parallel play and unoccupied play require additional research due to the possibility of idiosyncratic classroom findings as well as our lack of *a priori* hypotheses due to limited past evidence.

Connections between Temperament Traits and Social Behavior

The third goal of the study was to determine the connections between temperament traits and social behaviors. This was done through zero-order correlations among the variables (collapsed across the entire school year), regressions to determine whether children's traits could predict their social behavior over and above age and sex, and finally through multilevel modeling to explore the temporal aspect of whether prior temperament traits or social behaviors could predict social behaviors or temperament traits at subsequent time points.

Correlations between temperament traits and social behavior. See Table 7 for all zero-order correlations between temperament traits and social behavior. Low effortful control was associated with more teacher-oriented social behavior, $r(53)=-.43$, $p=.001$, indicating that teachers spent more time engaging with children who displayed less self-regulation. In addition, higher levels of negative emotionality were associated with fewer onlooking behaviors, $r(53)=-.30$, $p=.03$. Positive emotionality was related to several social behaviors. Higher levels of positive emotionality were associated with less solitary constructive play ($r(53)=-.40$, $p<.01$), unoccupied behavior ($r(53)=-.42$, $p<.01$), and parallel play ($r(53)=-.49$, $p<.001$). Higher levels of positive emotionality were strongly related to higher levels of social play, $r(53)=.71$, $p<.001$, implying that children with higher positive emotionality were more often engaged with other children and less often playing by themselves.

Predicting social behavior from temperament traits. Hierarchical multiple regression analyses were conducted for each social behavior. In each regression, age and sex were entered as the first step, while positive emotionality, negative emotionality, and effortful control were entered as a block in the second step. Results are presented in Tables 8-14. Of note, temperament traits significantly predicted social behaviors above and beyond sex and age for all social behaviors except onlooking behaviors (for which the block of temperament traits was approaching significance) and solitary nonconstructive play.

The predictive validity of specific traits differed depending on the social behavior in question. For solitary constructive play, positive emotionality had the strongest predictive validity, β=-.60. For unoccupied behavior, all three traits were uniquely predictive, with higher levels of negative emotionality (β=.29) and effortful control (β=.48) predicting more unoccupied behavior and higher levels of positive emotionality (β=-.49) predicting less unoccupied behavior. For teacher-oriented behavior, all three temperament traits were unique predictors; higher levels of negative emotionality (β=-.29) and effortful control (β=-.63) predicted less time engaged in teacher-oriented behavior, while higher levels of positive emotionality (β=.47) predicted more time engaged in teacher-oriented behavior. For parallel play, positive emotionality and effortful control were both significant predictors, with lower levels of positive emotionality (β=-.70) and higher levels of effortful control (β=.36) predicting more parallel play. More social play was strongly predicted by higher levels of positive emotionality, β=.68. Finally, although the predictive validity of the set of temperament traits for onlooking behavior did not reach conventional significance levels, negative emotionality was a unique predictor, β=-.36, indicating that lower levels negative emotionality was related to more onlooking behavior. Overall, among

the significant models, temperament traits predicted between 25% (solitary constructive play) and 51% (social play) of the variance in social behavior.

A few of the unique temperament trait predictors that emerged in these models did not have zero-order correlations with the corresponding social behavior. Specifically, for unoccupied behavior, all three temperament traits were unique predictors in the model while only positive emotionality held a zero-order correlation with unoccupied behavior. For parallel play, a similar situation emerged; both effortful control and positive emotionality were significant in the regression model while only positive emotionality held a zero-order correlation with parallel play. Finally, for teacher-oriented behavior, all of the temperament traits were uniquely predictive, but only effortful control had a zero-order association with teacher-oriented behavior.

Therefore, suppression effects were examined in order to parse apart whether the addition of age and sex or the addition of the other temperament traits prompted the changing association. By examining partial correlations between temperament traits and social behavior while controlling for age and sex as well as the partial correlations between each temperament trait and social behavior with the other temperament traits held constant, we determined that the other temperament traits better explained the suppression effects than age and sex. When holding effortful control and negative emotionality constant, partial-order correlations between positive emotionality and the social behaviors (i.e., unoccupied, parallel, and teacher-oriented) emerged as significant, and the associations were in the same direction in the partial-order correlations as they were as unique predictors in the regression models. That is, the unique contribution of positive emotionality in predicting less unoccupied behavior, less parallel play, and more teacher-oriented behavior in our regression equations became apparent in partial-order correlations after controlling for negative emotionality and effortful control (specifically, for

unoccupied behavior and parallel play, the significant partial-order associations became stronger, while for teacher-oriented play, the partial-order association became significant). A similar pattern was also found for effortful control when positive and negative emotionality were held constant. The regression equations indicated that more effortful control uniquely predicted more unoccupied behavior, more parallel play, and less teacher-oriented behavior; partial-order correlations that controlled for positive and negative emotionality between effortful control and the social behavior matched these unique predictions (that is, the significant partial-order association between effortful control and teacher-oriented behavior became stronger while the partial-order associations between effortful control and parallel play as well as effortful control and unoccupied play became significant). Finally, negative emotionality became significantly correlated with unoccupied behavior after controlling for the other traits, but not teacher-oriented behavior, although the nonsignificant correlation was in the same direction as in the regression equation. Controlling for sex and age also did not yield a connection between negative emotionality and teacher-oriented behavior, prompting the conclusion that negative emotionality is only uniquely predictive when the variance of both the demographic factors *and* the temperament trait factors is removed. It is of note that the unique variance of each temperament trait (i.e., that not overlapping with the other traits) seems even more important to social behaviors after accounting for age, sex, and the contributions of the other traits.

Next, we examined the possibility of trait by trait interactions, since children with different trait configurations may engage in different social behaviors (e.g., a child with high positive emotionality and high effortful control may engage in more social play than a child with high positive emotionality and low effortful control). Social behaviors and temperament traits were z-scored, and temperament trait interaction terms were created from the multiplied z-scores.

Initial regression equations were conducted for each social behavior, where age and sex were entered as the first block, the three temperament traits were entered as the second block, and the three interaction terms were entered as the third block. For models in which the third block provided significant change to the model and an interaction term was a unique predictor, a follow-up regression model was run with age and sex as the first block, the relevant two temperament traits as the second block, and the corresponding interaction term as the third block.

In our initial regressions, the interaction blocks for solitary constructive play and social play were significant. For both, positive emotionality by effortful control was the only uniquely predictive interaction term. Therefore, two regression equations were run with solitary constructive play and social play as the dependent variables, age and sex as the first block, positive emotionality and effortful control as the second block, and the positive emotionality by effortful control interaction term as the third block. These models are detailed in Tables 15-16.

To follow up these significant interactions, simple slopes were calculated with three levels of effortful control to determine how children differ between low and high positive emotionality on the social behavior. Although simple slope lines are traditionally separated by a standard deviation, because of our small sample size and intercorrelation among the traits, no participant met criteria for having high positive emotionality ($z > 0$) while also having low effortful control ($z < -1$). Therefore, a *z*-score of .5 was used for effortful control instead, with high effortful control ($z > .5$), moderate effortful control ($-.5 < z < .5$), and low effortful control ($z < .5$) considered in combination with low positive emotionality ($z < 0$) and high positive emotionality ($z > 0$) in determining how children participate differently in solitary constructive and social play. Figure 1 and Figure 2 plot the raw data points of the lines for each social

behavior. Using either the traditional one standard deviation or our half standard deviation method, the slope of each line for both social behaviors differed significantly from zero.

Inspection of simple slopes for solitary constructive play indicate that children with high positive emotionality engage in solitary constructive at similar rates regardless of their level of effortful control, although children with low effortful control and high positive emotionality engage in solitary constructive play the least. However, when children have low positive emotionality, they engage in solitary constructive play at different rates. Unexpectedly, among low positive emotionality children, those with the highest levels of effortful control engage in solitary constructive play the least (almost a standard deviation below average), while children with the lowest levels of effortful control engage in solitary constructive behavior the most (almost a standard deviation above average).

For social play, children with higher positive emotionality engage in more social play regardless of their level of effortful control; that is, when positive emotionality was high, effortful control made no difference in predicting social play. However, for children with low positive emotionality, both low and high effortful control children engaged in the least amount of social play, while children with moderate levels of effortful control engaged in social play at higher rates. Perhaps children with low levels of positive emotionality but moderate amounts of effortful control maintain interest in interacting with others and engage in more successful social bids, whereas low positive emotionality-low effortful control children may be less desirable playmates, and low positive emotionality-high effortful control children may direct their attention elsewhere.

In both of these, the low positive emotionality-high effortful control children were engaging in these social behaviors almost a standard deviation less than their peers. Because of

our mutually exclusive social behavior coding system, we were able to examine what social behaviors these particular children were engaging in instead. Overall, these children seemed to engage in more parallel play (*z*-scored *M*=1.30) and more unoccupied play (*z*-scored *M*=1.84) than other children, as well as less teacher-oriented behavior (*z*-scored *M*=-1.30) than other children.

Predicting subsequent waves of social behavior from temperament traits. Next, multilevel modeling was used to determine whether temperament traits predicted social behaviors in the next wave. To maximize power, seven waves were used (wave 1=August 30-October 15, as few observations were conducted in August and September, wave 2=October 16-November 15, wave 3=November 16-December 15, wave 4=January, wave 5=February, wave 6=March, wave 7=April-May). Waves ranged from containing 2,167 observations (wave 1) to 5,384 observations (wave 2), *M*=3,821, *SD*=1196.26. We utilized a restricted maximum likelihood method of estimation and reported on the final estimation of fixed effects with robust standard errors as well as the final estimation of variance components. Each social behavior was entered as the outcome variable with temperament traits entered together as predictors. Since effortful control had significant linear change over time and was an independent variable in each model, wave was then added to determine if temperament traits held predictive power above and beyond the effect of time. To capture the longitudinal piece with each wave of temperament traits predicting the subsequent wave of the social behavior, temperament traits were lagged a wave behind. Models where at least one temperament trait significantly predicted subsequent social behaviors are detailed in Tables 17-21. Temperament traits predicted or approached significance as predictors for all social behaviors except onlooking and social play. For each

social behavior entered separately as the outcome variable, mathematically we can represent the model

$$SocialBehavior_{ti} = \beta_0 + \beta_1 * POSE_{ti} + \beta_2 * EC_{ti} + \beta_3 * NEGE_{ti} + \beta_4 * WAVE_{ti} + r_{0i} + e_{ti}$$

where $SocialBehavior_{ti}$ is the proportion of time the child was engaged in that social behavior in each wave. B_0 is the intercept term that was allowed to vary across persons, and e_{ti} is the error term. The three temperament trait variables were always added together and lagged a wave behind. If any of the temperament traits were significant predictors, $\beta_4 * WAVE_{ti}$ was included in the model to determine if the associations were maintained above and beyond the effect of time. Finally, r_{0i} indicates between subject variability in overall level of social behavior.

For solitary constructive play, effortful control approached significance as a negative predictor, b=-.02, p=.07, where higher levels of effortful control predicted less subsequent solitary constructive play. This relationship was identical when wave was included in the model. A similar finding was found for solitary nonconstructive play when wave was not included, with higher levels of effortful control predicting less solitary nonconstructive play in subsequent waves, b=-.04, p=.02. Negative emotionality was also a negative predictor, b=-.14, p=.05. However, effortful control became a nonsignificant predictor after wave was included in the model. In addition, the impact of negative emotionality was attenuated to approaching significance, b=-.12, p=.10.

For unoccupied behavior, both with and without wave entered into the model, all three temperament traits were significant predictors. More unoccupied behavior in later waves was predicted by less positive emotionality, b=-.12, p<.001, more effortful control, b=.13, p<.001, and more negative emotionality, b=.23, p=.01, in prior waves.

For teacher-oriented behavior, more positive emotionality predicted more teacher-oriented behavior when wave was not included, b=.10, p=.02. However, when wave was factored in, positive emotionality was no longer a significant predictor; instead, both effortful control and negative emotionality now emerged as predictors. Lower levels of effortful control, b=-.13, p<.001, as well as lower levels of negative emotionality, b=-.31, p=.03, predicted more teacher-oriented behavior in the following waves.

Finally, for parallel play, more positive emotionality predicted less parallel play, but only when wave was not included, b=-.04, p=.04. Once wave was included, temperament traits were not significant predictors of parallel play.

Predicting subsequent waves of temperament traits from social behavior. Next, we considered the idea that engaging in certain social behaviors may predict children's temperament traits in the next wave. To tackle this possibility, we again used seven waves. Each temperament trait was entered as the outcome variable while each social behavior was entered as a predictor. In addition to effortful control, solitary nonconstructive play also demonstrated significant linear change; therefore, for models in which either of these variables was included, wave was also entered as a predictor to determine if the model held above and beyond the effect of time. That is, for models where no clear time trend would be expected, wave was not included.[1] Models where the social behavior was a significant predictor are detailed in Tables 22-31. Of note, while several social behaviors were able to predict subsequent positive emotionality and effortful control, none of the social behaviors predicted negative emotionality. However, all social behaviors aside from unoccupied and onlooking behaviors held predictive power in determining later temperament traits.

[1]For the sake of thoroughness, when entering the effect of wave would have altered the resulting model, the differences are detailed in a table footnote for that model.

Solitary constructive play negatively predicted later levels of positive emotionality, *b*=-.611, *p*<.01, and approached significance as a negative predictor of effortful control, *b*=-.38, *p*=.06. That is, higher levels of solitary constructive play at earlier time points predicted lower levels of positive emotionality and effortful control at later time points. However, after wave was factored in, only positive emotionality was still negatively predicted by solitary constructive play, *b*=-.42, *p*=.02. Similarly, higher levels of solitary nonconstructive play predicted lower levels of positive emotionality (*b*=-.62, *p*=.03) and lower levels of effortful control (*b*=-.97, *p*<.001) at later time points, but both of these relationships disappeared after wave was included.

More teacher-oriented behavior predicted more subsequent positive emotionality (*b*=.73, *p*<.001) as well as more effortful control (*b*=.48, *p*<.001) at subsequent waves; however, once wave was taken into account, only positive emotionality continued to be significantly predicted by prior teacher-oriented behavior, *b*=.36, *p*<.01. Next, more parallel play significantly predicted less positive emotionality (*b*=-.67, *p*<.001) in addition to less effortful control (*b*=-.45, *p*=.001) in later waves, but after wave was factored in, the association disappeared for effortful control and only approached significance for positive emotionality, *b*=-.23, *p*=.06.

Finally, social play was not predictive of either positive emotionality when wave was not factored in. However, once wave was included in the model, positive emotionality was significantly predicted by social play. Specifically, more social play in prior waves predicted higher levels of positive emotionality, *b*=.54, *p*<.01.

Centrality

The final goal of the current study was to examine the role of children's degree centrality, or number of social ties, in the classroom (Freeman, 1978, 1979). As previously described, a pair of children were considered to have a social tie if they interacted with each other more than

was predicted from the number of times each child in the pair was observed and the number of times each child in the pair was observed in social play. Because these social network data violate the statistical assumption of independence, traditional parametric approaches to testing significance were not appropriate. Instead, to test significance, random permutation tests were utilized because they do not have a priori assumptions of normal distributions or independence and instead only require independent and identically distributed random errors (Anderson, 2001; Good, 2005). Random permutations also require that observations are exchangeable; for example, in the current study, this assumption dictates that every child must have an equal opportunity to interact with every other child. For permutation tests with regressions, as it is used presently, the null hypothesis assumes that the true slope is zero. The test randomly re-orders (shuffles) the dependent variable to recalculate the associations between the independent and dependent variables (specifically, shuffling the values of the dependent variables while the independent variable values remain fixed). For the current study, the regressions were programmed to randomly permute 10,000 times. Significance, then, is calculated by comparing the original observed value with the distribution of values obtained from the 10,000 random permutations. The specific probability level is calculated as the proportion of distribution values that exceed the absolute value of the original observed value. Significance levels are interpreted in the traditional parametric manner (i.e., $p<.05$ would be interpreted as statistically significant, while $p<.10$ would be interpreted as approaching significance). However, unlike traditional tests, because these probability values result from random permutations, the exact probability values are not static. Standardized beta values are provided and should be interpreted through the same lens as normal regression beta weights; however, since the standard error is typically biased in permutation tests, it is not provided.

Because of the assumption of exchangeability, separate regressions were run for each classroom. In addition, children were split up into two groups in each classroom: children who attended for the morning only, and children who attended for the afternoon only. Children who attended for the full day were included in both groups. Therefore, for every random permutation regression, each child had the ability to have a social tie with every other child included in that analysis, fulfilling the exchangeability assumption. The average temperament traits and social behavior of the four groups (children attending in the morning or full day in the younger classroom, children attending in the morning or full day in the older classroom, children attending in the afternoon or full day in the younger classroom, and children attending in the afternoon or full day in the older classroom) were grouped to cover (a) the full year, and (b) the first half of the year or fall semester (August-December), and second half or spring semester (January-May).

First, zero-order correlations were conducted to determine connections between children's social ties and their temperament traits and social behaviors. When looking at associations for the full year, correlations were only found in the younger classroom. For those attending school in the afternoon or full day in the younger classroom, unexpectedly, children's number of social ties positively correlated with time spent in unoccupied play, r=.50, as well as negative emotionality, r=.55, p<.05. For those attending school in the morning or full day in the younger classroom, number of social ties was strongly correlated with time spent in parallel play, r=.71, p=.001.

When semesters were examined separately, no significant correlations were found in the fall semester. However, in spring semester, those in the younger classroom who attended in the morning or full day with more social ties spent less time in solitary nonconstructive play, r=-.54,

$p<.05$. Finally, multiple correlations were found between social ties and social behavior and temperament traits in the older classroom for children who attended in the afternoon or for the full day. Those who had more social ties spent more time engaging in onlooking behavior, $r=.59$, had higher levels of positive emotionality, $r=.66$, as well as higher levels of effortful control, $r=.66$, all $p<.01$. In addition, those children who spent less time in parallel play had more social ties, $r=-.54$.

Next, regressions were performed to investigate whether children's social ties could predict children's social behavior. Age and sex were added as control variables first for each equation. Next, social ties were entered with age and sex. Finally, for the full model, age, sex, social ties, and the temperament trait variables were entered together to predict social behavior. Each social behavior was examined three times (full year, fall semester, and spring semester) for each of the four groups (morning and full day kids in the younger classroom, afternoon and full day kids in the younger classroom, morning and full day kids in the older classroom, and afternoon and full day kids in the older classroom). While some models were significant due to the contribution of temperament traits, only models where social ties were a significant or approaching significant predictor are discussed here. All models where social ties were a significant or approaching significant predictor of a social behavior are summarized in Tables 32-40.

Results for the full year indicated that in the older classroom, for children who attended in the afternoon and for the full day, the number of social ties was negatively predictive of solitary constructive play after accounting for age and sex, $b=-.01$, $\beta=-.51$. That is, as children possessed more social ties, they engaged in less solitary constructive play. However, social ties were no longer a significant predictor of solitary constructive play once temperament traits were

taken into account, suggesting that children's temperament traits better account for variation in solitary constructive play.

A few additional associations were approaching significance for the full year, although none held after introducing temperament traits to the model. In the younger class for children who attended in the morning and for the full day, a greater number of social ties predicted more parallel play after age and sex were taken into account, b=.01, β=.55. In the younger class for children who attended in the afternoon and for the full day, a greater number of social ties predicted more unoccupied behavior, b=.01, β=.50, as well as less teacher-oriented behavior, b=-.01, β=-.46, after controlling for age and sex.

For the fall semester, only one prediction was found, and it approached significance. For children in the younger class who attended in the morning and for the full day, a greater number of social ties predicted less time engaged in solitary constructive play only after temperament traits were taken into account, b=-.00, β=-.49; that is, social ties only approached significance in the final model.

For the spring semester, social ties predicted social behaviors in several models. In the older classroom for children who attended in the morning and for the full day, a greater number social ties was significantly predictive of more solitary nonconstructive play, but only in the full model, b=.01, β=.71. For children in the older classroom who attended in the afternoon and for the full day, a greater number of social ties also significantly predicted of less time spent in parallel play, and this held both when controlling just for sex and age, b=-.01, β=-.67, but also in the full model, b=-.01, β=-1.32. This finding was in the opposite direction of the approaching-significance above finding with the younger classroom who attended in the morning and for the full day for the full year. For these children in the older classroom who attended in the afternoon

and for the full day, social ties approached significance as a positive predictor of more onlooking behavior, b=.00, β=.59, but not in the full model. Finally, for children in the younger classroom who attended in the morning and for the full day, a greater number of social ties significantly predicted less solitary nonconstructive play after controlling for sex and age, b=-.01, β=-.54, and approached significance in the full model, b=-.01, β=-.49. This final finding was also in the opposite direction of what was found for the older classroom.

DISCUSSION

This investigation was guided by four primary goals: (1) to examine children's temperament traits in the classroom setting with regard to trait structure; differences in trait levels attributable to child sex, class, and attendance status; and temporal change in traits across the school year; (2) to similarly assess children's social behaviors in terms of structure and sex, age, and attendance status differences; (3) to determine connections between temperament traits and social behaviors, with particular attention to the ability of temperament traits and social behavior to predict subsequent time points; and (4) to evaluate the role of social ties in predicting social behaviors. Although many of our hypotheses were exploratory in nature, general hypotheses pointing to overall relations within the constructs found partial support. In the following sections, discussion and implications for the findings of each of these goals are explored.

Children's Temperament Traits

Our factor analysis, like previous studies, resulted in three higher-order temperament composites: positive emotionality, negative emotionality, and effortful control. However, the structure of the resulting composites differed from Wilson and Durbin (2012), who used identical lower-order temperament traits and rating procedures to the current study, but evaluated traits in the context of structured laboratory tasks as opposed to classroom observations. Wilson and Durbin (2012) found that positive emotionality consisted of positive affect, anticipatory positive affect, initiative, sociability, and engagement; effortful control consisted of compliance, attentional control, reverse-scored activity level, and reverse-scored impulsivity; and negative emotionality consisted of sadness, fear, and anger. While the composition of negative emotionality remained the same in the current study, positive emotionality shifted to be made up

of positive affect, anticipatory positive affect, sociability, activity, and impulsivity, while effortful control was made up of compliance, attentional control, engagement, and initiative. Essentially, initiative and engagement switched places with activity and impulsivity. This is in line with the conceptualization in Rothbart's model as well as the categorization used in the Else-Quest et al. (2006) meta-analysis (Else-Quest et al., 2006; Rothbart et al., 2001).

There are several possible reasons for the differing trait composition between Wilson and Durbin (2010) and the present findings. Since children were predominantly observed during free play periods, impulsivity and activity may be implicated in play behaviors that are more likely to co-occur with instances of positive affect and other peers (reflecting sociability). That is, children's levels of activity in a classroom during free play may be inherently more social and prompt more positive affect as compared to highly active children in a solitary laboratory setting. The appropriateness of the temperament trait expression becomes an important consideration. While higher levels of activity and impulsivity may indicate lower self-regulation and effortful control in a laboratory setting where children are expected to complete specific tasks, during free play higher levels of activity and impulsivity may be less related to children's ability to modulate their responses to the environment, as free play affords greater levels of choice and fewer demands. By contrast, while initiative and engagement may be related to positive emotionality in a laboratory setting because they both indicate more interest in the task and experimenter rather than explicit persistence, in a classroom setting during a free play period, they may fall more in line with the persistence piece, indicating more well-controlled and compliant children. It should be noted, however, that initiative cross-loaded heavily with both domains, indicating its split role, while engagement only loaded on the effortful control

composite. The differences between initiative and engagement and how they manifest in a preschool context deserve further attention.

While positive and negative emotionality were unrelated, higher levels of effortful control were related to higher levels of positive emotionality and lower levels of negative emotionality. The orthogonal nature of positive and negative emotionality matches findings from laboratory assessments using the same coding system (Durbin et al., 2005), and the connections found with effortful control speak to its overlap with more positively-valenced expression in a free play periods. Boys who attended preschool for the full day in particular had higher positive emotionality than girls who attended for the full day, while girls who attended preschool for the full day had higher negative emotionality than girls who attended for half the day. Although neither Olino et al. (2013) nor Else-Quest et al. (2006) found differences on positive emotionality by child sex, the way in which the traits were grouped may have prompted the finding. As discussed above, perhaps placing activity under positive emotionality drove this finding, as Gagne, Miller, and Goldsmith (2013) as well as Olino et al. (2013) found that boys display higher levels of activity. This also matches with the meta-analysis of Else-Quest et al. (2006), who similarly incorporated activity level into their measure of positive emotionality and found that boys have higher levels of positive emotionality. While our measures of temperament did assess activity level, it was beyond the scope of the current study to examine each of the subtraits. For the difference found between girls' negative emotionality, perhaps the very low base-rate of negative emotionality in general simply meant that full-day girls received more observations in general, which allowed greater chance of negative emotions to be captured during the negative-emotion event codes; upon inspection, girls who attended for the full day received about twice as many observations as girls who attended for half the day. However,

Else-Quest et al. (2006) found the strongest difference between boys and girls on effortful control, which the current study failed to find. Since the meta-analysis was largely based on parent report, it may be that parents include children's sex in conceptualizing expectations for behavior, perhaps indicating there may be some sex-stereotype bias for parent reports of this trait.

Temporally, only effortful control demonstrated robust change over time, increasing across the year in both classrooms and for both sexes. Increases in effortful control may indicate children's growing self-regulatory abilities and adjustment to a classroom context, although it is interesting that both classrooms did not differ significantly at the beginning of the year. Coders may have taken children's age into account when rating effortful control traits, expecting higher levels for children in the older classroom and scoring them accordingly. Overall, little research has explicitly explored the evolution of temperament traits across one school year, so it becomes difficult to fit these findings into a broader research context. However, this increase in effortful control is consistent with the goal of the preschool context in boosting children's self-regulation. Although this premise is certainly encouraging and supportive of early education endeavors, additional research is necessary to replicate these findings.

Children's Social Behaviors

For social behavior, we failed to find compelling evidence of an underlying structure. While the combination of solitary constructive, solitary nonconstructive, unoccupied, and reverse-scored social play hung together, from a descriptive standpoint, this factor may not provide much additional information (e.g., children who are by themselves are by default not socially interacting; these categories are mutually exclusive). If perhaps a more revealing composite emerged (e.g., a combination of onlooking behavior, parallel play, and teacher-

oriented behavior), then this factor structure would have received attention. However, while our lower-order temperament trait variables lend themselves well to exploring informative higher-order composites, our social behavior categories were originally created to capture the range of behaviors children exhibit in a classroom rather than being empirically or theoretically derived (e.g., Mize & Ladd, 1988). Play is also more interactive and may be more influenced by the environment itself, including both structure of the physical environment as well as the behaviors of peers and teachers, such that some of the variance in and overlap across social behaviors emerges from different causal factors than latent social behavior disposition. Therefore, to best capture the unique aspects of children's behaviors, we retained the original seven categories (solitary constructive play, solitary nonconstructive play, unoccupied behavior, onlooking behavior, parallel play, teacher-oriented behavior, parallel play, and social play) for all analyses.

A higher degree of social play was related to a lower degree of most other behaviors, including solitary constructive and nonconstructive play, unoccupied behavior, onlooking, and teacher-oriented behavior. The lack of connection between solitary constructive and solitary nonconstructive is noteworthy; despite their conceptual similarities (children engaging in some activity alone), they seem to function independently. Interestingly, more time spent engaging in teacher-oriented behavior was related to less time spent in unoccupied play and parallel play. As children aged, they also spent less time in unoccupied and parallel play and more time engaged in social play, which fits well with developmental expectations; however, it is perhaps surprising that levels of teacher-oriented behaviors do not decrease with age as children become more independent. The content of teacher-oriented behaviors may be changing (e.g., disciplinary versus playful), and although this distinction was recorded by our coders, it was beyond the scope of the current study to examine this change. Finally, even after controlling for age, girls

spent more time unoccupied than boys. Since the social behavior categories were quite broad (e.g., did not separate for types of social play that may be more sex-stereotyped, such as more active and less active play, as was found in Martin & Fabes, 2001), additional research is necessary to determine what qualities are unique to unoccupied behaviors that may distinguish boys and girls.

Change was also evident in children's engagement in various social behaviors across the year; in fact, all social behaviors aside from unoccupied and parallel play demonstrated significant change in some way. Solitary constructive play for the older classroom decreased for the year, increasing again at the end of the year, while solitary nonconstructive play decreased across the year for both classrooms. Onlooking behavior in the younger classroom jumped at the third wave and then decreased to its lowest point at the end of the year. Social play, which was predicted to rise across the year due to increased familiarity with peers and surroundings, actually only changed for boys, and in the opposite direction predicted (it was higher in the first half of the year and lower in the second). Teacher-oriented behavior followed a less consistent pattern; the younger classroom fluctuated across the year while the older classroom engaged in more teacher-oriented behavior in the second half of the year than the first half. These trends are difficult to explain without additional research across schools to determine if these changes represent subtle developmental patterns or instead are unique to the specific preschool's functioning. As with temperament trait findings, placing these findings into the existing literature is difficult because of the dearth of research on this topic.

Connections between Temperament Traits and Social Behavior

Unsurprisingly, when explored cumulatively across the year, aspects of temperament traits and social behaviors were interrelated. Specifically, higher levels of effortful control

related to lower levels of teacher-oriented behavior, which is perhaps surprising when thinking about how children higher in effortful control might make more dutiful, attentive students. However, since most observations occurred during free play periods, it is possible that students who were less well-regulated received more attention from the teacher for behavior management reasons. Higher levels of negative emotionality related to fewer onlooking behaviors, which prompts questions about how onlooking might function differently than other behaviors such as parallel play. Finally, higher positive emotionality was connected to a number of social behaviors, most notably social play; the two constructs were strongly related, in that more positive emotionality was related to more social play. More positive emotionality was also related to fewer instances of solitary constructive play, unoccupied behavior, and parallel play. In light of the overlap between positive emotionality and social play both negatively relating to solitary constructive and unoccupied play, their differences become noteworthy (i.e., positive emotionality alone relating to parallel play, and social play alone relating to onlooking and solitary nonconstructive play).

Children's temperament traits were able to predict concurrent social behaviors above age and sex. In particular, positive emotionality emerged as a significant predictor of every social behavior except onlooking and solitary nonconstructive behaviors, where the models were not significant. All three temperament traits were significant predictors of unoccupied and teacher-oriented behavior, and effortful control was uniquely predictive in parallel play. The combinations of temperament traits and their varying levels of importance in predicting social behaviors range from more obvious (e.g., the role of positive emotionality in social play) to less (e.g., the role of all three temperament traits in unoccupied behavior), prompting further questions about the function different social behaviors serve in the classroom, and how these

temperament traits may interact with one another. Interactions of positive emotionality and effortful control may be especially important for children with low positive emotionality.

Finally, temperament traits and social behavior were examined temporally to determine their ability to predict subsequent waves. Significant findings were revealed in both directions, indicating that there is likely reciprocal influence. Higher levels of effortful control at previous time points predicted less solitary constructive play (with or without the effect of wave), less solitary nonconstructive play (without wave), less teacher-oriented behavior (with wave), and more unoccupied play (with or without wave) at subsequent time points. Higher levels of positive emotionality also predicted less unoccupied play (with or without wave), more teacher-oriented play (without wave), and less parallel play (without wave) at later time points. Finally, higher levels of negative emotionality predicted more unoccupied behaviors (with or without wave), less solitary nonconstructive play (with wave), and less teacher-oriented behavior (with wave) at later time points.

When we reversed the lagging of constructs, social behaviors predicted subsequent temperament traits. Specifically, multiple social behaviors predicted later levels of positive emotionality after wave was taken into account. Less solitary constructive play (with and without wave), less solitary nonconstructive play (without wave), more teacher-oriented behavior (with and without wave), less parallel play (without wave), and more social play (with wave) predicted higher levels of subsequent positive emotionality. On the other hand, while effortful control was predictive of multiple social behaviors, only social play positively predicted later levels of effortful control after wave was factored in. Without the effect of wave, less solitary nonconstructive play, less parallel play, and more teacher-oriented behavior predicted later levels of higher effortful control.

Increases in positive emotionality and effortful control seem largely driven by identical social behaviors (i.e., solitary constructive and nonconstructive play, teacher-oriented behavior, and parallel play), although more social play predicts later levels of higher positive emotionality but not effortful control. However, when predicting subsequent waves of social behavior from earlier temperament traits, positive emotionality and effortful control overlap less (i.e., only effortful control plays a role in predicting solitary and nonconstructive play; they operate in opposite directions in predicting unoccupied play; and effortful control was not involved in predicting parallel play). As effortful control emerges across the year, perhaps it plays more of a role in determining the types of behaviors in which children are likely to engage, while changes in positive emotionality may be more reactive to the solitary or social situations in which children find themselves.

The Role of Social Ties

Findings with children's degree centrality are difficult to explain and prompt further questions about the structure of preschool classroom networks, and, in particular, what might make children who attend school for the morning and full day different from children who attend school for the afternoon and full day in terms of the role of friendship ties. Unexpected findings, such as the strong correlation between negative emotionality and number of social ties for children attending school in the afternoon or full day for younger children, may indicate interactional patterns (e.g., negative emotionality may be a frequent result of social interactions with peers, such as with aggression; Roseth, Pellegrini, Bohn, Van Ryzin, & Vance, 2007) or be a spurious findings; future research will help to clarify these possibilities. Although it is challenging to form conclusions when none of the models held for both students in the morning and the afternoon in either classroom, the models in which degree centrality was a significant

predictor were largely either in the spring semester and/or relevant to the younger, but not older, classroom. In the spring semester, children have been exposed to their peers for a longer period of time and degree centrality may be more established, which may lend itself to more stability in social behavior engagement. In addition, perhaps children's degree centrality matters more in predicting younger children's social behaviors, where children who are more socially connected may engage more predictably in certain social behaviors as compared to older children who may engage in various social behaviors regardless of their degree centrality.

Other research has documented the importance of children's peer exposure across the school year. In particular, the work of Roseth et al. (2007) and Hanish et al. (2005) illustrate the importance of longitudinal models. Roseth et al. (2007) found non-linear change in aggression rates over time in preschoolers using an observational procedure similar to ours; specifically, rates of physical and verbal aggression increased during the beginning of the school year when peer groups were initially being formed and aggression played a large role in negotiating social dominance, but decreased across the year as peer groups stabilized. Hanish et al. (2005) examined children's exposure to externalizing peers in order to explore peer contagion processes. Interestingly, in terms of peer selection, the most social children (engaging in social play nearly 60% of the time observed on average) did not choose play partners who demonstrated externalizing behaviors. Given the strong evidence for sex-segregation in child play, it was notable that Hanish et al. (2005) found that boys who engaged in more externalizing behaviors played equally with externalizing boys and girls; however, this was also not true for girls, as girls spent more time with externalizing girls than externalizing boys. The peer contagion effect was also stronger for girls than boys, where more time spent with externalizing peers predicted more anxiety, hyperactivity, and aggressive behavior later on in the year. In light

of these findings, future studies should continue to examine children's friendship ties longitudinally.

Limitations and Future Directions

Although the design of this study is well-poised to answer many questions about preschoolers' temperament traits and social behavior, it is not without its limitations. With so many exploratory possibilities, some investigations were beyond the scope of the present study. Specifically, examining the sex of friendship partners as well as the stability of these same-sex friendships would be an exciting future avenue. Martin and Fabes (2001) found that the vast majority of children are sex-segregated in their play; looking into the temperament trait composition of the friendship dyads by sex as well as if there are differences between boys and girls in the stability of their specific friendships would expand these findings. More broadly, future studies could examine how similar children are on their temperament traits within friendships as well as the directionality (e.g., do children who have similar levels of effortful control become friends, or do children begin to match more in effortful control after becoming friends?).

Another limitation of the current study was its restrictions in examining the temporal aspects of children's temperament traits and social behavior across the year. Through grouping into waves (4 and 7), we were able to begin to understand children's change over time, but more sophisticated statistical techniques would permit us to use all available information without losing subtle fluctuations through averaging. In addition, since we know that social behavior change did not follow a consistently linear change pattern over time, it is quite possible that temperament traits do not predict subsequent social behaviors (and vice versa) in a linear way, as our analyses demand. Null findings here may not actually indicate a lack of relation, but rather a

non-linear one. While it is beyond the scope of the current study to delve into more fine-grained analysis of this matter, we hope to further explore this temporal piece in future studies.

Although the current study provided much information about children's behaviors over time, multi-method assessment will always paint a fuller picture. Future studies might consider combining longitudinal classroom observation with parent reports and/or laboratory assessments to compare children's temperament traits across the environments. While parent reports are criticized for providing less direct evidence of children's temperament traits and laboratory assessments critiqued for their staged tasks (e.g., Majdandžic & Van Den Boom, 2007, but see Lo, Vroman, & Durbin, 2015), combining evidence from naturalistic observation with informant reports would allow researchers to better understand how the same child might operate in a variety of contexts: in their caregivers' eyes, in novel situations, and longitudinally, in school.

Because this study was conducted in one university-affiliated preschool, results should be considered carefully in terms of generalizability. Teachers play an important role in determining allowable social behaviors as well as the overall climate of the school. Other preschools may have more displays of physical aggression or rough-and-tumble play, which were virtually nonexistent in our sample, or higher levels of negative emotionality (e.g., prompted by more instances of aggression or less supervision from lower student-teacher ratios). In fact, Acar et al. (2015) found that teacher identity explained a large portion of the variance in children's observed peer interactions across eight preschools. In addition, as this study was strictly observational, we did not have the control permitted in a laboratory setting or manipulations available. However, despite these limitations, the current study made great strides in better understanding the cumulative and temporal associations between preschoolers' temperament traits, social behavior, and friendship ties in a naturalistic classroom setting.

APPENDICES

Appendix A: Tables

Table 1: *Zero-order Correlations among Lower-order Temperament Traits*

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Activity	-											
2. Sociability	.84**	-										
3. Impulsivity	.58**	.48**	-									
4. PE	.88**	.77**	.37*	-								
5. Ant. PE	.66**	.56**	.42*	.76**	-							
6. Engagement	.25	.52**	-.15	.21	-.11	-						
7. Initiative	.63**	.77**	.28*	.59**	.23	.71**	-					
8. Compliance	.18	.20	-.39**	.28*	-.10	.54**	.38**	-				
9. Atten. Control	.08	.34*	-.46**	.17	-.18	.86**	.59**	.68**	-			
10. Sadness	-.20	-.20	.09	-.26	-.04	-.32*	-.16	-.46**	-.28*	-		
11. Anger	.19	.28*	.46**	.14	.29*	-.10	.16	-.55**	-.25	.39**	-	
12. Fear	-.12	-.05	-.15	-.12	-.22	.18	-.10	.00	.09	.18	.07	-

Note. *p<.05. **p<.01.

Table 2: *Factor Loadings Based on a PCA with Oblimin Rotation for Temperament Traits*

	Positive Emotionality	Effortful Control	Negative Emotionality
Activity	**.93**		
Sociability	**.85**	-.44	
Impulsivity	**.69**	.31	.35
PE	**.89**		-.23
Anticipatory PE	**.80**	.22	
Engagement		**-.94**	
Initiative	.62	**-.69**	
Compliance		**-.65**	-.69
Attentional Control		**-.93**	-.32
Sadness		.24	**.74**
Anger	.37		**.77**
Fear	-.26	-.31	**.43**

Note. Factor loadings <.2 are suppressed.

Table 3: *Means, Standard Deviations, and Ranges of Lower- and Higher-Order Temperament Traits*

	Mean	SD	Minimum	Maximum
Higher-order PE:				
Activity	1.24	.20	.83	1.79
Sociability	1.36	.27	.84	1.98
Impulsivity	.41	.19	.09	.99
PE	.87	.37	.31	1.91
Anticipatory PE	.23	.11	.02	.43
Higher-order EC:				
Engagement	1.85	.18	1.41	2.31
Initiative	1.27	.26	.79	1.97
Compliance	2.40	.24	1.90	3.00
Attention	1.91	.18	1.26	2.39
Higher-order NE:				
Sadness	.04	.05	.00	.21
Anger	.03	.03	.00	.13
Fear	.00	.00	.00	.02
Higher-order PE	.82	.20	.49	1.27
Higher-order EC	1.86	.18	1.48	2.30
Higher-order NE	.02	.02	.00	.09

Note. Temperament traits were rated on a 0-3 scale. These descriptive statistics have been averaged across the school year.

Table 4: *Means, Standard Deviations, and Ranges of Temperament Traits by Wave*

	Mean	SD	Minimum	Maximum
Wave 1:				
PE	.70	.14	.35	1.01
EC	1.69	.14	1.35	1.99
NE	.02	.02	.00	.08
Wave 2:				
PE	.68	.14	.33	1.09
EC	1.73	.15	1.44	2.13
NE	.02	.03	.00	.16
Wave 3:				
PE	.90	.23	.45	1.33
EC	1.89	.23	1.54	2.50
NE	.02	.03	.00	.11
Wave 4:				
PE	.91	.30	.47	1.57
EC	2.02	.21	1.42	2.50
NE	.02	.03	.00	.12

Table 5: *Means, Standard Deviations, and Ranges of Social Behaviors*

	Mean	SD	Minimum	Maximum
Solitary Constructive	.09	.03	.03	.19
Solitary Nonconstructive	.08	.03	.01	.15
Unoccupied	.19	.05	.10	.33
Teacher-oriented	.26	.05	.17	.44
Onlooking	.04	.02	.01	.08
Parallel	.12	.04	.04	.20
Social	.22	.08	.05	.36

Note. Social behaviors have been calculated as proportions, with number of behaviors observed in that category divided by total number of observed behaviors. These descriptive statistics have been averaged across the school year.

Table 6: *Means, Standard Deviations, and Ranges of Social Behavior by Wave*

	Mean	SD	Minimum	Maximum
Wave 1:				
Sol. Const.	.10	.07	.00	.37
Sol. Nonconst.	.09	.05	.00	.21
Unoccupied	.16	.06	.04	.32
Teacher-oriented	.24	.07	.10	.40
Onlooking	.04	.03	.00	.15
Parallel	.14	.06	.03	.30
Social	.23	.09	.05	.40
Wave 2:				
Sol. Const.	.10	.06	.01	.29
Sol. Nonconst.	.09	.05	.00	.21
Unoccupied	.19	.07	.03	.35
Teacher-oriented	.20	.06	.10	.32
Onlooking	.04	.03	.00	.11
Parallel	.13	.08	.02	.43
Social	.25	.12	.05	.50
Wave 3:				
Sol. Const.	.08	.05	.00	.23
Sol. Nonconst.	.07	.04	.00	.16
Unoccupied	.19	.07	.06	.40
Teacher-oriented	.31	.09	.00	.50
Onlooking	.04	.04	.00	.20
Parallel	.12	.06	.02	.40
Social	.19	.09	.00	.37
Wave 4:				
Sol. Const.	.10	.07	.00	.33
Sol. Nonconst.	.06	.04	.00	.14
Unoccupied	.20	.09	.02	.42
Teacher-oriented	.29	.09	.13	.52
Onlooking	.03	.02	.00	.07
Parallel	.10	.05	.00	.23
Social	.22	.09	.03	.42

Note. All descriptive statistics are presented as proportions of times observed in each social behavior in that wave divided by total number of observations for that child in that wave.

Table 7: *Zero-order Correlations between Temperament Traits and Social Behaviors*

	Positive Emotionality	Negative Emotionality	Effortful Control
Solitary Constructive	-.40**	.01	-.26†
Solitary Nonconstructive	-.11	.09	-.06
Unoccupied	-.42**	.19	.16
Teacher-oriented	.10	.00	-.43**
Onlooking	-.24†	-.30*	.05
Parallel	-.49***	-.09	.14
Social	.71***	-.05	.24†

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 8: *Summary of Hierarchical Regression Analysis for Variables Predicting Solitary Constructive Play*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	-.01	.01	-.19	-1.32	.00	.01	-.03	-.16
Age	.00	.00	.05	.36	.00	.00	.43	2.62
Temp. Traits								
PE					-.10	.03	-.60	-3.40**
EC					-.02	.03	-.12	-.86
NE					.03	.22	.02	.121
R^2	.035				.28			
F for change in R^2	.90				5.40**			

Note. *p<.05. **p<.01.

Table 9: *Summary of Hierarchical Regression Analysis for Variables Predicting Solitary Nonconstructive Play*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	.01	.01	.11	.77	.01	.01	.18	1.13
Age	.00	.00	-.12	-.84	.00	.00	.00	-.03
Temp. Traits								
PE					-.02	.03	-.16	-.80
EC					.00	.03	.01	.08
NE					.17	.20	.13	.81
R^2	.02				.05			
F for change in R^2	.59				.39			

Note. *p<.05. **p<.01.

Table 10: *Summary of Hierarchical Regression Analysis for Variables Predicting Unoccupied Behavior*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	-.03	.01	-.30	-2.34*	-.02	.01	-.20	-1.65
Age	.00	.00	-.30	-2.37*	.00	.00	-.06	-.38
Temp. Traits								
PE					-.13	.04	-.49	-3.10**
EC					.14	.04	.48	3.75**
NE					.67	.30	.29	2.23*
R^2	.20				.42			
F for change in R^2	6.25**				6.03**			

Note. *p<.05. **p<.01.

Table 11: *Summary of Hierarchical Regression Analysis for Variables Predicting Teacher-Oriented Behavior*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	.00	.02	-.09	-.61	-.02	.01	-.15	-1.17
Age	.00	.00	.02	.13	.00	.00	-.19	-1.19
Temp. Traits								
PE					.13	.05	.47	2.72**
EC					-.19	.04	-.63	-4.54**
NE					-.69	.33	-.29	-2.10*
R^2	.01				.33			
F for change in R^2	.19				7.41**			

Note. *p<.05. **p<.01.

Table 12: *Summary of Hierarchical Regression Analysis for Variables Predicting Onlooking Behavior*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	.00	.01	-.04	-.30	.00	.01	-.11	-.78
Age	.00	.00	-.22	-1.57	.00	.00	-.22	-1.28
Temp. Traits								
PE					-.01	.02	-.09	-.45
EC					.00	.01	.01	.07
NE					-.27	.11	-.36	-2.39*
R^2	.05				.19			
F for change in R^2	1.34				2.58†			

Note. †p<.10. *p<.05. **p<.01.

Table 13: *Summary of Hierarchical Regression Analysis for Variables Predicting Parallel Play*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	.02	.01	.22	1.67	.03	.01	.34	2.85**
Age	.00	.00	-.38	-2.96**	.00	.00	-.02	-.13
Temp. Traits								
PE					-.14	.03	-.70	-4.53**
EC					.08	.03	.36	2.84**
NE					.17	.21	.10	.83
R^2	.18				.45			
F for change in R^2	5.29**				7.81**			

Note. †p<.10. *p<.05. **p<.01.

Table 14: *Summary of Hierarchical Regression Analysis for Variables Predicting Social Play*

	Model 1				Model 2			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	.03	.02	.20	1.63	.01	.02	.05	.41
Age	.00	.00	.44	3.53**	.00	.00	.04	.27
Temp. Traits								
PE					.28	.06	.68	4.67**
EC					.00	.05	-.02	-.19
NE					-.08	.42	-.02	-.19
R^2	.25				.51			
F for change in R^2	8.34**				8.21**			

Note. *p<.05. **p<.01.

Table 15: *Predicting Solitary Constructive Play with the Interaction of Positive Emotionality by Effortful Control*

	Model 1				*Model 2*				*Model 3*			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	-.37	.28	-.19	-1.32	-.06	.26	-.03	-.23	.12	.21	.06	.59
Age	.01	.02	.05	.36	.06	.02	.42	2.71**	.06	.02	.40	3.20**
Temp. Traits												
PE					-.59	.17	-.59	-3.55**	-.89	.15	-.89	-6.10***
EC					-.13	.13	-.13	-1.00	-.20	.11	-.20	-1.85†
PExEC									.42	.08	.61	5.21***
R^2	.04				.28				.55			
F for change in R^2	.90				8.27**				27.13***			

Note. †p<.10. *p<.05. **p<.01. ***p<.001. Standardized beta values identical to unstandardized for temperament traits because of z-scoring.

Table 16: *Predicting Social Play with the Interaction of Positive Emotionality by Effortful Control*

	Model 1				*Model 2*				*Model 3*			
Variable	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*	*B*	*SE B*	*β*	*t*
Gender	.40	.25	.20	1.63	.10	.21	.05	.49	.00	.20	.00	.01
Age	.06	.02	.44	3.53**	.01	.02	.04	.04	.01	.02	.05	.46
Temp. Traits												
PE					.67	.14	.67	4.87***	.84	.14	.84	6.06***
EC					-.01	.11	-.01	-.13	.02	.10	.02	.02
PExEC									-.24	.08	-.34	-3.07**
R^2	.25				.51				.59			
F for change in R^2	8.34**				12.55***				9.43**			

Note. †p<.10. *p<.05. **p<.01. ***p<.001. Standardized beta values identical to unstandardized for temperament traits because of z-scoring.

Table 17: *Summary of Multilevel Modeling Predicting Subsequent Solitary Constructive Play from Lagged Temperament Traits*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	.19	.03	5.36***	.20	.04	5.20***
Temp. Traits						
PE	-.02	.02	-1.01	-.03	.02	-1.37
EC	-.04	.02	-1.76†	-.05	.03	-1.84†
NE	-.14	.13	-1.11	-.16	.10	-1.64
Wave				.00	.00	.66
Variance	.00	.02	70.35**	.00	.02	67.17*

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 18: *Summary of Multilevel Modeling Predicting Subsequent Solitary Nonconstructive Play from Lagged Temperament Traits*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	.14	.03	5.69***	.12	.02	5.33***
Temp. Traits						
PE	.01	.01	.93	.02	.02	1.58
EC	-.04	.02	-2.44*	-.02	.01	-1.44
NE	-.14	.07	-1.96*	-.12	.07	-1.66†
Wave				.00	.00	-2.38*
Variance	.00	.02	101.99***	.00	.02	112.85***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 19: *Summary of Multilevel Modeling Predicting Subsequent Unoccupied Behavior from Lagged Temperament Traits*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	.04	.04	.96	.06	.04	1.51
Temp. Traits						
PE	-.12	.02	-5.86***	-.13	.02	-5.64***
EC	.13	.02	6.12***	.12	.02	5.10***
NE	.43	.17	2.53*	.41	.17	2.41*
Wave				.00	.00	1.06
Variance	.00	.04	113.53***	.00	.04	112.64***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 20: *Summary of Multilevel Modeling Predicting Subsequent Teacher-Oriented Behavior from Lagged Temperament Traits*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	.24	.04	5.92***	.39	.05	7.34***
Temp. Traits						
PE	.09	.04	2.37*	.05	.03	1.32
EC	-.01	.03	-.48	-.13	.04	-3.59***
NE	-.19	.15	-1.20	-.31	.14	-2.16*
Wave				.03	.00	6.63***
Variance	.00	.04	92.73***	.00	.04	93.24***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 21: *Summary of Multilevel Modeling Predicting Subsequent Parallel Play from Lagged Temperament Traits*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	.22	.04	5.54***	.16	.04	3.70***
Temp. Traits						
PE	-.04	.02	-2.09*	-.02	.02	-1.03
EC	-.04	.02	-1.58	.00	.03	.11
NE	-.07	.09	-.81	-.03	.09	-.31
Wave				-.01	.00	-2.86**
Variance	.00	.02	79.48**	.00	.03	90.80***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 22: *Summary of Multilevel Modeling Predicting Subsequent Positive Emotionality from Lagged Solitary Constructive Play*

Variable	*B*	*SE*	*t*
Intercept	.89	.04	21.27***
Solitary Constructive Play	-.61	.22	-2.74**
Variance	.02	.14	168.90***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 23: *Summary of Multilevel Modeling Predicting Subsequent Positive Emotionality from Lagged Solitary Nonconstructive Play*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	.88	.04	21.33***	.60	.04	15.58***
Sol. Nonconst.	-.62	.28	-2.23*	.09	.28	.33
Wave				.06	.01	6.12***
Variance	.03	.17	210.67***	.03	.18	327.15***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values. Wave was included due to linear change over the year in solitary nonconstructive play.

Table 24: *Summary of Multilevel Modeling Predicting Subsequent Positive Emotionality from Lagged Teacher-Oriented Behavior*

Variable	*B*	*SE*	*t*
Intercept	.64	.03	18.84***
Teacher-Oriented Behavior	.73	.14	5.23***
Variance	.03	.18	295.52***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

Table 25: *Summary of Multilevel Modeling Predicting Subsequent Positive Emotionality from Lagged Parallel Play*

Variable	*B*	*SE*	*t*
Intercept	.92	.04	24.61***
Parallel Play[2]	-.67	.19	-3.56***
Variance	.03	.17	227.64***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

[2] When wave was included in the model, parallel play approached significance as a predictor of positive emotionality, t=-1.89, p<.10, B=-.23, SE=.12. Wave became a significant predictor, t=5.76, p<.001, B=.05, SE=.01.

Table 26: *Summary of Multilevel Modeling Predicting Subsequent Positive Emotionality from Lagged Social Play*

Variable	*B*	*SE*	*t*
Intercept	.78	.05	15.36***
Social Play[3]	.23	.15	1.57
Variance	.03	.16	200.38***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values.

[3] When wave was included in the model, social play became a significant positive predictor of positive emotionality, t=3.16, p<.01, B=.54, SE=.12. Wave was also significant, t=6.30, p<.001, B=.06, SE=.12.

Table 27: *Summary of Multilevel Modeling Predicting Subsequent Effortful Control from Lagged Solitary Constructive Play*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	1.90	.04	53.77***	1.63	.03	60.90***
Sol. Const.	-.38	.20	-1.93†	-.20	.14	-1.41
Wave				.07	.01	11.87***
Variance	.01	.11	132.74***	.13	.02	281.67***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values. Wave was included due to linear change over the year in effortful control.

Table 28: *Summary of Multilevel Modeling Predicting Subsequent Effortful Control from Lagged Solitary Nonconstructive Play*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	1.95	.03	64.28***	1.64	.03	52.54***
Sol. Nonconst.	-.97	.23	-4.14***	-.24	.20	-1.19
Wave				.074	.01	10.66***
Variance	.14	.02	177.16***	.14	.02	321.78***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values. Wave was included due to linear change over the year in effortful control as well as solitary nonconstructive play.

Table 29: *Summary of Multilevel Modeling Predicting Subsequent Effortful Control from Lagged Teacher-Oriented Behavior*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	1.73	.04	49.29***	1.63	.03	52.29***
Teacher-Oriented	.48	.13	3.65***	-.06	.11	-.54
Wave				.07	.01	11.96***
Variance	.02	.14	223.08***	.02	.14	346.34***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values. Wave was included due to linear change over the year in effortful control.

Table 30: *Summary of Multilevel Modeling Predicting Subsequent Effortful Control from Lagged Parallel Play*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	1.93	.03	60.13***	1.60	.03	56.96***
Parallel Play	-.45	.14	-3.24**	.11	.10	1.07
Wave				.07	.01	11.49***
Variance	.02	.13	169.37***	.02	.14	329.42***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values. Wave was included due to linear change over the year in effortful control.

Table 31: *Summary of Multilevel Modeling Predicting Subsequent Effortful Control from Lagged Social Play*

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	1.91	.04	44.26***	1.62	.03	56.37***
Social Play	-.18	.14	-1.32	-.02	.08	-.28
Wave				.07	.01	11.69***
Variance	.14	.02	187.65***	.02	.14	354.14***

Note. †p<.10. *p<.05. **p<.01. ***p<.001. The variance component is provided at the level of the intercept, and standard deviation and chi-square values are provided rather than standard errors and *t* values. Wave was included due to linear change over the year in effortful control.

Table 32: *Summary of Permutation Regressions for Solitary Constructive Play for the Full Year, Older Classroom (PM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	.00	.31	.22	.00	.45	.08†	.00	.13	.74
Sex	-.03	-.37	.13	-.02	-.29	.26	.01	.13	.70
Social Ties				-.01	-.51	.04*	-.01	-.47	.12
Temp. Traits									
PE							-.23	-.96	.05†
EC							.67	.35	.41
NE							.14	.66	.26
R^2	.24			.47			.71		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 33: *Summary of Permutation Regressions for Parallel Play for the Full Year, Younger Classroom (AM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	-.00	-.35	.24	-.00	-.25	.41	-.00	-.48	.20
Sex	.05	.71	.01*	.03	.41	.23	.02	.36	.31
Social Ties				.01	.55	.05†	.01	.50	.12
Temp. Traits									
PE							.06	.15	.65
EC							-.27	-.26	.49
NE							.04	.10	.80
R^2	.38			.61			.69		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 34: *Summary of Permutation Regressions for Unoccupied Behavior for the Full Year, Younger Classroom (PM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	-.00	-.34	.25	-.00	-.21	.49	-.00	-.12	.73
Sex	-.01	-.10	.74	-.03	-.23	.45	.01	.13	.75
Social Ties				.01	.50	.06†	-.00	-.02	.96
Temp. Traits									
PE							-.59	-.95	.004**
EC							-.16	-.08	.91
NE							.00	.00	1.00
R^2	.16			.39			.87		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 35: *Summary of Permutation Regressions for Teacher-Oriented Behavior for the Full Year, Younger Classroom (PM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	-.00	-.20	.52	-.00	-.31	.31	-.00	-.20	.56
Sex	-.01	-.18	.56	-.01	-.06	.84	-.02	-.22	.60
Social Ties				-.01	-.46	.09†	-.00	-.18	.66
Temp. Traits									
PE							.21	.44	.23
EC							.88	.59	.37
NE							.11	.30	.72
R^2	.10			.29			.46		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 36: *Summary of Permutation Regressions for Solitary Constructive Play for the Fall Semester, Younger Classroom (AM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	.00	.20	.50	.00	.18	.56	.00	.33	.45
Sex	-.02	-.29	.34	-.01	-.20	.51	-.02	-.29	.42
Social Ties				-.00	-.26	.34	-.00	-.49	.07†
Temp. Traits									
PE							-.24	-.69	.01
EC							-.08	-.22	.70
NE							-.60	-.61	.22
R^2	.07			.13			.77		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 37: *Summary of Permutation Regressions for Solitary Nonconstructive Behavior for the Spring Semester, Older Classroom (AM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	.00	.16	.54	.00	.17	.52	.00	.48	.17
Sex	-.01	-.14	.62	-.01	-.14	.59	-.02	-.57	.06†
Social Ties				.00	.16	.50	.01	.71	.02*
Temp. Traits									
PE							.05	.40	.33
EC							-.16	-1.06	.00**
NE							-.10	-.10	.72
R^2	.06			.08			.62		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 38: *Summary of Permutation Regressions for Onlooking Behavior for the Spring Semester, Older Classroom (PM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	-.00	-.28	.26	-.00	-.01	.98	.00	.16	.73
Sex	.01	.29	.24	.00	.01	1.00	.01	.18	.58
Social Ties				.00	.59	.06†	.00	.74	.26
Temp. Traits									
PE							-.09	-.91	.22
EC							.05	.69	.27
NE							.13	.20	.58
R^2	.15			.35			.47		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 39: *Summary of Permutation Regressions for Parallel Play for the Spring Semester, Older Classroom (PM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	.00	.43	.08	.00	.12	.70	.00	-.35	.47
Sex	.00	.08	.74	.02	.41	.15	.02	.33	.30
Social Ties				-.01	-.67	.03*	-.01	-1.32	.03*
Temp. Traits									
PE							.11	.72	.33
EC							.03	.03	.96
NE							.08	.07	.84
R^2	.20			.46			.59		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Table 40: *Summary of Permutation Regressions for Solitary Nonconstructive Play for the Spring Semester, Younger Classroom (AM & Full Day)*

	Model 1			*Model 2*			*Model 3*		
Variable	*B*	*β*	*p*	*B*	*β*	*p*	*B*	*β*	*p*
Age	-.00	-.15	.62	-.00	-.13	.66	.00	.03	.94
Sex	.01	.17	.57	.02	.20	.50	.02	.25	.43
Social Ties				-.01	-.54	.02*	-.01	-.49	.05†
Temp. Traits									
PE							-.01	-.03	.93
EC							-.09	-.23	.45
NE							.30	.25	.45
R^2	.03			.32			.44		

Note. †p<.10. *p<.05. **p<.01. ***p<.001.

Appendix B: Figures

Figure 1: *Simple Slopes for Solitary Constructive Behavior from Positive Emotionality and Effortful Control*

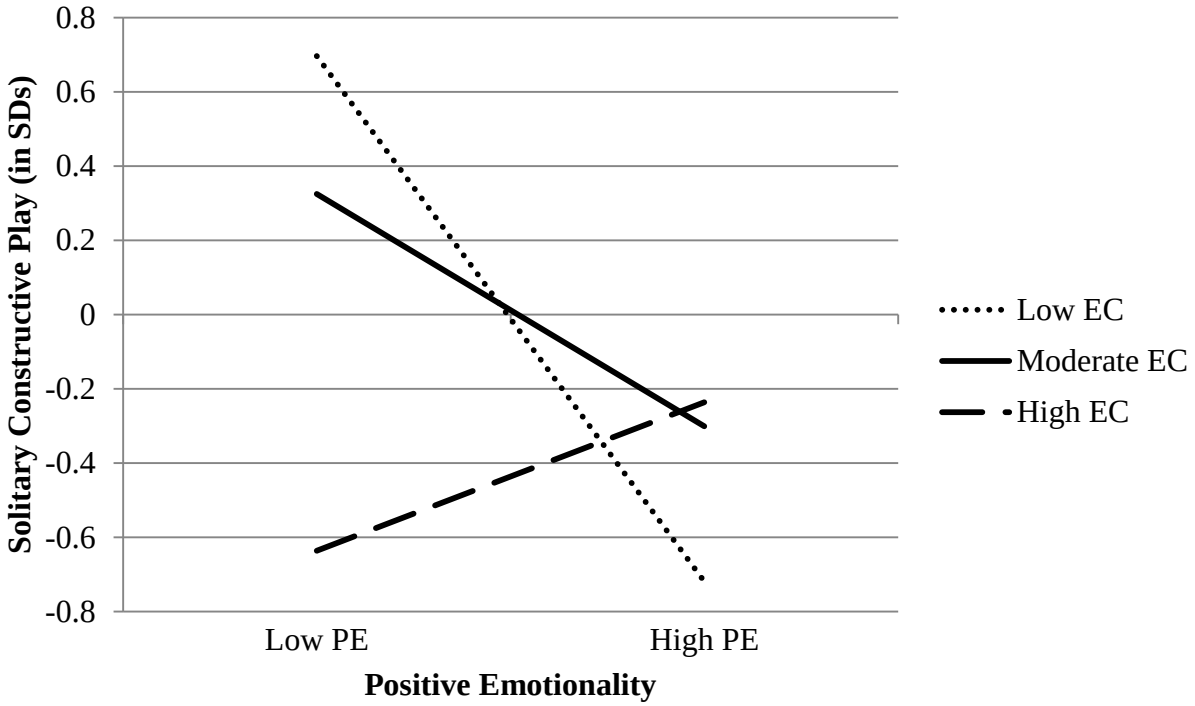
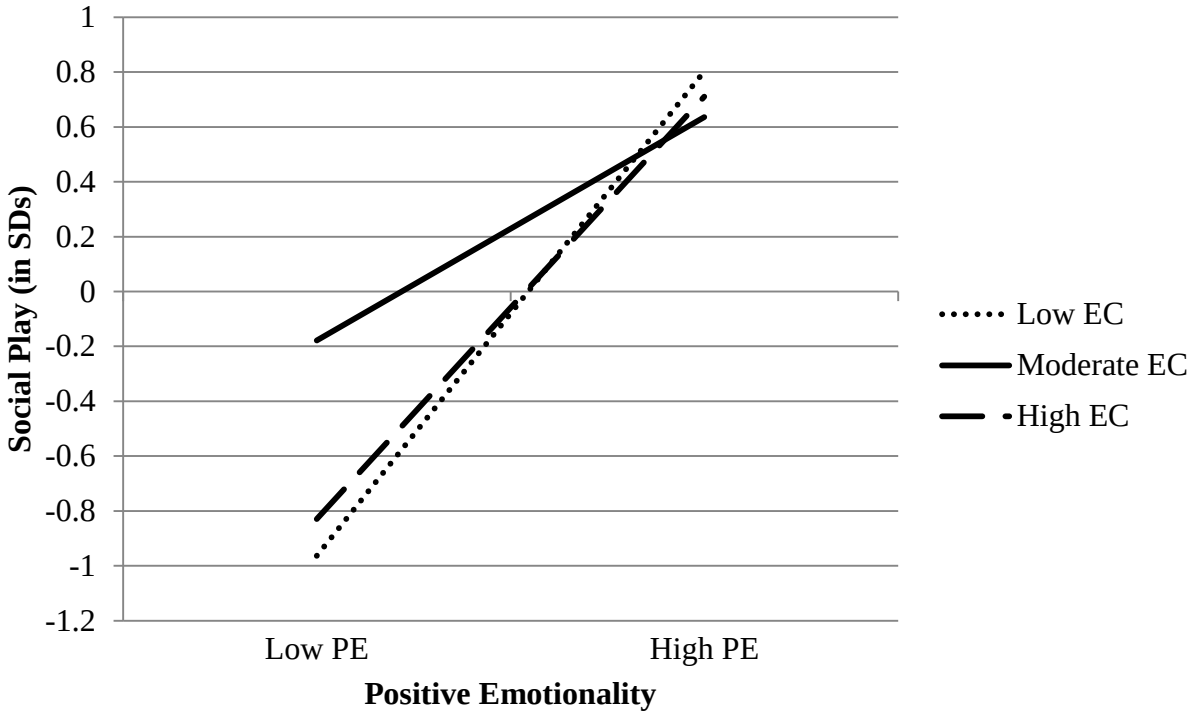


Figure 2: *Simple Slopes for Social Play from Positive Emotionality and Effortful Control*



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