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Effortful control and school adjustment: The moderating role of classroom chaos

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Abstract

Guided by the person by environment framework, the primary goal of this study was to determine whether classroom chaos moderated the relation between effortful control and kindergarteners' school adjustment. Classroom observers reported on children's (N = 301) effortful control in the fall. In the spring, teachers reported on classroom chaos and school adjustment outcomes (teacher-student relationship closeness and conflict, and school liking and avoidance). Cross-level interactions between effortful control and classroom chaos predicting school adjustment outcomes were assessed. A consistent pattern of interactions between effortful control and classroom chaos indicated that the relations between effortful control and the school adjustment outcomes were strongest in high chaos classrooms. Post-hoc analyses indicated that classroom chaos was associated with poor school adjustment when effortful control was low, suggesting that the combination of high chaos and low effortful control was associated with the poorest school outcomes.

Keywords

self-regulation; classroom environment; kindergarten; teacher-student relationships; school liking and avoidance; chaos

Introduction

Educators and scholars have emphasized the importance of a successful adjustment during the transition to formal schooling for children's later learning and academic progress (Early, Pianta, Taylor, & Cox, 2001; Entwisle & Alexander, 1993; Pianta & Cox, 1999; Rimm-

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Kaufman & Pianta, 2000). For many children, kindergarten is likely the first experience in a formal learning environment. The environment of contemporary kindergarten classrooms is much more structured than preschool, childcare, or home settings, and kindergarteners are required to comply with school rules and procedures, attend to academic material for longer periods of time, and interact appropriately with teachers and peers (Rimm-Kaufman & Pianta, 2000). There is some support for the hypothesis that children high in effortful control (EC; the self-regulation component of temperament) are better equipped than those low in EC to handle these new demands (Eisenberg, Valiente, & Eggum, 2010; Love, Logue, Trudeau, & Thayer, 1992), but the relation of EC to school outcomes is generally modest, suggesting that the strength of the relation might be impacted by other contextual factors such as classroom chaos.

The classroom environment, including organization and behavior management, plays an important role in children's school adjustment (Ponitz, Rimm-Kaufman, Grimm, & Curby, 2009; Wachs, Gurkas, & Kontos, 2004). Scholars have extended and refined the original model of adaptation termed "person X environment" (Coie et al., 1993), to include children's temperament (i.e., "temperament X environment," *henceforth* referred to as T X E) in predicting adjustment (Ladd, Birch, & Buhs, 1999; Rothbart & Bates, 2006). Specifically, school adjustment is described as a function of risk and protective factors that are found within the child (i.e., temperament) and the environment (i.e., classroom; Ladd et al., 1999). When temperament is not adequately supported by the environment, adjustment is unlikely to be optimal (Rothbart & Bates, 2006). We sought to extend this literature by examining whether the strength of the relation between EC and school adjustment is moderated by classroom chaos.

Early Indicators of School Adjustment

Children's relationships with their teachers and emotional engagement are key indicators of early school adjustment (teacher–student relationship closeness and conflict, and school liking and avoidance). Studies demonstrated that the quality of the teacher–student relationship (TSR) is a robust predictor of early school success (Baker, 2006; Hamre & Pianta, 2001; Pianta & Stuhlman, 2004). Specifically, close TSRs, characterized by warm interactions, are related to positive peer relationships, engagement in classroom activities, and academic achievement, whereas TSR conflict is related to difficulty with peer relationships and poorer academic achievement (Birch & Ladd, 1997; Hamre & Pianta, 2001; Pianta & Stuhlman, 2004).

Although the literature on children's emotional engagement at school is not quite as developed as the literature on children's relationships with their teachers, scholars have found that emotional engagement in school is also an important component of school adjustment (Fredricks, Blumenfeld, & Paris, 2004; Ladd, Buhs, & Seid, 2000; Ladd & Dinella, 2009). Emotional engagement has been conceptualized by Fredricks, Blumenfeld, and Paris (2004) and others (Ladd et al., 2000; Ladd & Dinella, 2009) as children's interest in school and positive attitudes about school. In this study, school liking and avoidance were two aspects of children's emotional engagement that were examined as separate school adjustment outcomes. Researchers have found that school liking positively, and avoidance

negatively, predict behavioral engagement and academic achievement (Buhs, Ladd, & Herald, 2006; Ladd et al., 2000; Ladd & Dinella, 2009). Given the significance of the TSR and emotional engagement for school success, it is important to understand factors related to their development. The present study focuses on these four indicators of children's early school adjustment.

Children's EC and School Adjustment

EC, which has been conceptualized as an individual's ability to effectively manage behaviors, emotions, and thoughts, as well as "inhibit a dominant response and/or activate a subdominant response, to plan, and to detect errors" (Rothbart & Bates, 2006, p.129), is believed to play an important role in positive behavior, social interactions, and academic development (Blair & Raver, 2015; Clark, Pritchard, & Woodward, 2010; Eisenberg et al., 2010; Ponitz, Rimm-Kaufman, et al., 2009; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). Further, the individual components of EC—attentional control (e.g., focus on academic lessons) and inhibitory control (e.g., tuning out noise and distracting peers)—help children to adjust optimally to school (Blair, 2002; Eisenberg, Smith, & Spinrad, 2011).

Children's behavior relative to their classroom peers may be particularly important for understanding their early school adjustment. Several studies have found that children's behavioral problems (e.g., internalizing and externalizing) relative to their classroom peers' behavior problems predicted children's academic outcomes, such as their social competence in school and academic achievement (e.g., Bulotsky-Shearer, Dominguez, & Bell, 2012; Figlio, 2007; Yudron, Jones, & Raver, 2014). Only one study, to our knowledge, has examined children's EC relative to their classroom peers. Skibbe, Phillips, Day, Brophy-Herb, and Connor, (2012) found that child-level and average classroom peers' EC was positively related to individual child growth in literacy across the school year. Skibbe and colleagues (2012) argued that it is important to consider children's individual EC within the context of the classroom, which includes peers' EC. Given the limited research on children's EC relative to their classroom peers, the following review uses the extant literature on child-level EC and four indicators of children's school adjustment (TSR closeness and conflict and children's school liking and avoidance) as a guide for the focal research questions addressed by this study.

Children's EC and TSR quality—Theorists have proposed that children's EC is associated with the quality of their relationships with others, including their teachers (Eisenberg, Valiente, et al., 2010). Children who demonstrate high EC are able to control their emotions (e.g., anger, sadness) in ways that promote positive social interactions in school; thus, they may have more positive relationships with teachers (Diaz et al., 2015). Conversely, it may be more difficult for teachers to connect with children with low EC because their behaviors in school are less likely to be modulated or appropriately expressed (Eisenberg et al., 2010). Teachers and school administrators typically expect children to demonstrate self-regulation before entering kindergarten (Bassok, Latham, & Rorem, 2016; Blair & Raver, 2015), so failure to do so may create conflict between teachers and children. Children with higher EC are more likely to meet the expectations of teachers and subsequently adjust to school better than less regulated children (Ladd et al., 1999).

Findings from a few studies are consistent with the proposition that children's EC relates to the TSR. For example, EC has predicted lower TSR conflict, higher TSR closeness, and higher TSR quality (a composite measure of high closeness and low conflict) in preschool and kindergarten samples (Diaz et al., 2015; Rudasill & Rimm-Kaufman, 2008; Silva et al., 2011; Valiente, Swanson, & Lemery-Chalfant, 2012). Relatedly, both child inattention and impulsivity, measures closely related to low EC, have been associated with higher TSR conflict and lower TSR closeness from kindergarten to first grade (Portilla, Ballard, Adler, Boyce, & Obradovi, 2014). Evidence on the EC to TSR is somewhat lacking, thus additional research is needed to help clarify the conditions under which the associations between EC and TSR quality are present.

Children's EC and emotional engagement—Although few researchers have directly examined the relation between children's EC and their emotional engagement with school (i.e., school liking and avoidance), there are theoretical and empirical reasons to believe that an association exists. Eisenberg and colleagues (2010) theorized that because children with higher EC are able to regulate their emotions, they are more likely to participate in and enjoy being in school. Additionally, EC facilitates positive school relationships and academic success (Eisenberg et al., 2010); thus, children with higher EC may benefit from more enjoyable and less stressful academic and social experiences in the school environment, which in turn may lead to greater liking and less avoidance of school (see review by Fredricks et al., 2004).

There is limited empirical support for the direct association of EC with children's school liking and avoidance. Correlations at the zero-order level demonstrate a negative association between EC and school avoidance across time and reporters (Iyer, Kochenderfer-Ladd, Eisenberg, & Thompson, 2010; Swanson, Valiente, & Lemery-Chalfant, 2012). Although zero-order correlations are useful for understanding if a relation between EC and school avoidance exists, they may artificially inflate relations because zero-order correlations cannot account for variation that is due to theoretically and empirically meaningful controls such as age, sex, socioeconomic status (SES), ethnicity, and previous academic skills. In one study that included controls, a positive relation between EC and school liking was found, even when controlling for SES (Valiente, Lemery-Chalfant, & Castro, 2007). Similarly, in a sample of children with and without autism, a positive partial correlation, controlling for mental age of the child, was found between EC and school liking, but not school avoidance (Jahromi, Bryce, & Swanson, 2013). These studies suggest that EC is related to emotional engagement; however, evidence is sparse and additional studies are needed to help clarify the extent to which EC is related to school liking and avoidance and in what contexts.

Classroom Chaos and School Adjustment

Noise, crowding, and lack of routine or stability, all which contribute to chaos in the classroom, can be detrimental to children's school adjustment (Maxwell, 2010). In this study, environmental chaos in the classroom was the focus and defined as teachers' perceptions of high levels of noise, crowding, and disruptions as well as lack of structural and routine organization (Wachs et al., 2004). Based on evidence demonstrating that noise, crowding, and instability in classrooms can disrupt communication between students and

teachers as well as increase student withdrawal from classroom activities (as reviewed by Maxwell, 2010), we expected chaos in the classroom to hinder positive TSRs and disrupt emotional engagement in school. When classroom chaos is high, teachers may feel somewhat overwhelmed and have less time to develop positive relationships with students. Specifically, in noisy classrooms teachers may find it difficult to communicate with students as well as convey meaningful academic lessons (Maxwell, 2010). In classrooms where the mean level of externalizing behavior problems are high—a context in which there is likely more chaos due to a high rate of disruptive behaviors in the classroom environment—teachers report less TSR closeness and more conflict (Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008). Similarly, the lack of structure and crowding in chaotic classrooms may be stressful with fewer opportunities for fun and engaging learning activities leaving children feeling less enthusiastic about school (Loo & Smetana, 1978).

Chaos, as it is conceptualized in this study, mainly refers to physical disorganization and distractions in the classroom environment (Wachs et al., 2004). Maxwell's (2010) review of the relations between the specific components of classroom chaos, such as noise, crowding, and instability, and academic success as well as school adjustment provides a basis for expecting the broader construct of chaos (which was not considered in Maxwell's analysis) to be relevant to school adjustment. In the limited research specifically examining the composite construct of classroom chaos, scholars have found negative correlations of classroom chaos with academic success and behavioral compliance. Ponitz and colleagues (2009) found that, for boys, lower teacher-reported classroom chaos was related to higher reading and math scores at the end of first grade as well as gains in math scores from kindergarten to first grade. Additionally, children were more likely to comply with directives and correct behavior when classroom chaos was low (Wachs et al., 2004). In summary, classroom chaos may be an aspect of the classroom environment that is related to children's school adjustment.

Classroom Chaos as a Moderator Between EC and School Adjustment

To our knowledge, studies examining chaos as a moderator between EC and the four reviewed indicators of school adjustment (i.e., TSR closeness and conflict; school liking and avoidance) do not exist. However, according to the T X E perspective, children's outcomes can be best explained by the interaction between children's temperamental characteristics (e.g., EC) and their environment (e.g., classroom chaos; Rothbart & Bates, 2006). In support of the T X E hypothesis, a large body of literature demonstrates that chaos in the home environment moderates the association between child characteristics and behavioral and socioemotional adjustment outcomes, such that children with more difficult temperamental characteristics have more optimal outcomes when chaos is low than when chaos is high (Chen, Deater-Deckard, & Bell, 2014; Lemery-Chalfant, Kao, Swann, & Goldsmith, 2013; Wang, Deater-Deckard, Petrill, & Thompson, 2012). Although home chaos is different than classroom chaos, this literature provides a foundation for conceptualizing the role of classroom chaos in school adjustment.

In support of this prediction, some researchers have examined school and classroom climate as moderators between child characteristics and school adjustment as well as other academic

outcomes. For example, in early adolescence, school cohesion (i.e., students in the school have positive social relationships) was found to moderate the association between EC and conduct problems, such that the negative association between EC and conduct problems was present only in schools with low cohesion (Loukas & Murphy, 2007). Buyse and colleagues (2008) found an interaction between children's externalizing behavior and a composite of teachers' reports of their emotional support and classroom management in predicting conflict in the TSR. The negative association between individual children's externalizing behavior and conflict in the TSR was strongest when teachers reported low levels of classroom management and support (Buyse et al., 2008). One study found that when observed instructional support was low there was a negative association between difficult infant temperament and first grade TSR quality, however this association was not moderated by emotional support or classroom organization (Curby, Rudasill, Edwards, & Pérez-Edgar, 2011). The present study contributes to the literature by using a short-term longitudinal study to examine whether the association between children's EC and their school adjustment varied as a function of classroom chaos.

The Present Study

We sought to advance the research literature in three key ways. First, we examined the main effects of EC and classroom chaos with TSR closeness, TSR conflict, school liking and avoidance, while controlling for theoretically relevant covariates. Second, we examined how children's EC relative to their classroom peers' EC was related to their school adjustment by classroom mean centering EC in our models. Third, and of more importance, we tested whether classroom chaos moderated the relations between EC and early measures of school adjustment. In the present study, we included controls that have been empirically and theoretically linked to EC, the TSR, and emotional engagement in school, including initial literacy skills, children's age, sex, ethnicity, and familial SES (Hughes & Kwok, 2007; Rudasill, Reio, Stipanovic, & Taylor, 2010; Valiente et al., 2008), as well as controls that might contribute to classroom chaos, including teachers' years of teaching experience and education. Based on the limited findings in previous research, we hypothesized that classroom chaos would be negatively related to TSR closeness and school liking and positively related to TSR conflict and school avoidance. We also hypothesized that children's EC relative to their classroom peers' EC would be positively related to TSR closeness and school liking and negatively related to TSR conflict and school avoidance. Guided by the T X E perspective, we further hypothesized that classroom chaos would moderate the association between children's EC relative to their classroom peers' EC and school adjustment, such that the positive associations between EC and TSR closeness or school liking, and the negative relations with TSR conflict and school avoidance, would be strongest in high chaos classrooms.

Method

Participants

Participants for this study were recruited from five public elementary schools in a Southwest U.S. metropolitan area. Parents were presented with materials about enrollment and participation at two school events and through newsletters sent home. Children were

excluded from participating in the study if their sibling was already enrolled in the project. Two cohorts, recruited one year apart, participated in the present study (*n*s = 178 and 123, respectively for cohort 1 and 2). If children moved to new schools during the study, parents and the new elementary schools were contacted so that participation in the study could continue.

A total of 26 teachers and 301 kindergarteners (52% female) participated in the present study. Parents of kindergarteners provided consent for themselves and children provided assent (all percentages reported in this section were rounded to the nearest whole number). On average, children were 5.48 years old (*SD* = .35) in the fall of kindergarten. Thirty-four percent of participants were Caucasian, 53% were Hispanic (10% African American/Hispanic, 89% White/Hispanic, 1% multiracial/Hispanic), 2% were African American, 3% were Asian, 2% were American Indian, 1% were multiracial/non-Hispanic, and 6% were of unknown race/ethnicity. The majority of children were from two-parent homes (63%) and mostly children's mothers (67%) reported on demographic information. Reported family income ranged from $0-$9,999 to $100,000 or over, with a mean range of $60,000-$69,999. Of the participating children's mothers, 11% had less than a high school diploma, 18% had a high school degree or equivalent, 30% had some college education, 39% had graduated college or earned a higher degree, and 2% of the data for this item were missing. Of the participating children's fathers, 17% had less than a high school diploma, 21% had a high school degree or equivalent, 24% had some college education, 36% had graduated college or earned a higher degree, and 2% of the data for this item were missing.

Kindergarten teachers, on average, had 8.12 years of teaching experience (*SD* = 7.17). Of the participating teachers, 64% had a bachelor's degree, 9% had some graduate education, 24% had a master's degree, and 2% of the data were missing. On average, there were 11.58 participating children per classroom (*SD* = 8.86, minimum = 1, maximum = 16).

Procedure

In the fall, observers in the classroom reported on each participating child's EC, separate research assistants administered the Woodcock Johnson-III (WJ-III) Picture Vocabulary (PV) subtest, and parents reported on children's demographic characteristics. In the spring, teachers reported on their perceptions of the classroom chaos, their relationship with each participating child, each participating child's emotional engagement in school, as well as their own demographic characteristics. Teachers were paid $15 for each completed questionnaire packet (e.g., if a teacher completed a questionnaire packet for 20 children in her classroom, the classroom chaos questionnaire, and demographic information, she would receive $300).

Measures

EC—Two to three research assistants reported (1 = *extremely false* to 7 = *extremely true*) on the inhibitory control (4 items; e.g., "Can easily stop an activity when she/he is told no"; α = .93) and attention focusing (5 items; e.g., "When drawing or coloring in a book, shows strong concentration"; α = .95) subscales from the shortened version of the Child Behavior Questionnaire. Observers were in the classroom from approximately mid-September until

early December (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001). Previous studies have used teacher reports of EC using the CBQ to demonstrate validity with other objective assessments of EC (Sulik et al., 2009), as well as observer reports of children's attention and persistence (Taylor, Eisenberg, Spinrad, & Widaman, 2013), which supports the use of observer reported EC in the school context [blind]. Correlations amongst the two to three research assistants on the inhibitory control (r = .29 to r = .45, ps < .001) subscale and, separately, on the attention focusing (r = .32 to r = .39, ps < .001) subscale were modest, but this was expected because research assistants observed children in different contexts (e.g., different specials classes, different types of lessons taught in class) and at different times of day. Thus, subscale scores provided by the two to three research assistants were averaged so that each child had one inhibitory control and one attention focusing score. Consistent with previous research including teacher reports of attention focusing and inhibitory control in school (Sulik et al., 2009; Valiente et al., 2012), the correlation between the subscales was very high (r = .90, p < .001). Accordingly, an EC composite was created by averaging the two subscale scores. Child-level EC descriptive statistics are reported in Table 1. Average classroom-level EC was similar to child-level EC (M = 5.34, SD = .54, Min = 4.08, Max = 6.46).

Classroom chaos—In the spring, teachers rated 15 items (1 = *extremely false* to 5 = *extremely true*) about their perceptions of chaos in their classroom (e.g., "You can't hear yourself think in your classroom"; α = .84) using the Chaos Order and Hubbub Scale for classrooms (Classroom Chaos; Wachs et al., 2004). The Classroom Chaos measure has demonstrated stability through high test-retest reliability (.87; as reported by Wachs et al., 2004). Additionally, the Classroom Chaos measure has been negatively associated with the Early Childhood Environment Rating Scale, a well-established observational measure of classroom settings (Wachs et al., 2004).

School Adjustment

TSR—In the spring, teachers rated (1 = *definitely does not apply* to 5 = *definitely does apply*) items about their closeness (8 items; e.g., "I share an affectionate, warm relationship with this child"; α = .81) and conflict (7 items; e.g., "Dealing with this child drains my energy"; α = .90) with each participating child using the Teacher–Child Relationship Scale (Pianta, Steinberg, & Rollins, 1995). The validity of the TCRS has been demonstrated by evidence supporting the relation between the TCRS and elementary school children's grades and achievement on standardized tests of achievement (Hamre & Pianta, 2005).

Children's Emotional Engagement in School—In the spring, teachers rated (1 = *does not apply* to 3 = *certainly applies*) items addressing children's school liking (7 items; e.g., "Enjoys most classroom activities"; α = .87) and avoidance (6 items; e.g., "Asks how long until it is time to go home"; α = .81) using the School Liking and Avoidance Questionnaire (Birch & Ladd, 1997). The SLAQ has been found to predict children's classroom participation and academic achievement, supporting the concurrent validity of the measure (Ladd et al., 2000).

Covariates

Child Demographics—During recruitment, parents were asked whether or not their children were non-Hispanic or Hispanic (Hispanic; 0 = *non-Hispanic*, 1 = *Hispanic*). Parents also reported on their family income and their own level of education (1 = *less than a high school diploma*, 2 = *high school degree or equivalent*, 3 = *some college education*, 4 = *graduated college or earned a higher degree*). Mothers' and fathers' education were highly correlated ($r = .59$, $p < .001$), as was mothers' and fathers' education with family income ($r = .59$, $p < .001$; $r = .56$, $p < .001$, respectively). Mothers' and fathers' education were standardized and averaged to create a composite of parents' education, which was then averaged with the standardized family income measure to form a SES composite.

Vocabulary—In the fall, each child completed the PV subtest from the WJ-III (Woodcock, McGrew, & Mather, 2001). This standardized test assesses intellectual abilities and is appropriate for individuals ranging in age from 2 to 90. A *W* score was computed by the WJ-III software and allows for comparison to a normative population. Scores on the PV test in this sample were similar to 5 year-olds in a representative sample ($M = 468.21$, $SD = 16.70$; Woodcock, McGrew, & Mather, 2001).

Teacher Demographics—Teachers reported on their highest level of education (1 = *Bachelor's degree*, 2 = *some graduate work*, 3 = *Master's degree*, and 4 = *Doctoral degree*) and on the number of years they had been teaching (see Participants section for more details).

Analytic Plan

The data in the present study were analyzed using a cross-level two-level model[1]. Children's EC, conflict and closeness in the TSR, and school liking and avoidance were estimated at the child level (level one), and classroom chaos was estimated at the classroom-level (level two). To test the main hypotheses and properly model the hierarchical data structure, multilevel modeling was used to assess the cross-level interaction between children's EC and classroom chaos (Bauer & Curran, 2005). Children's EC was centered within classroom to avoid estimation errors due to the inclusion of within- and between-classroom variation that could arise when grand mean centering is used (see Appendix for results when EC was grand mean centered; Enders & Tofighi, 2007). The control variables and classroom chaos were grand mean centered. All models were estimated in MPlus 7.0 (Muthén & Muthén, 1998). Full Information Maximum Likelihood was used to handle missing data. Children who had missing data on both the EC and chaos variables (as a result of moving) were excluded from these analyses ($n = 15$). T-tests demonstrated that cohort was unrelated to any of the focal study variables or controls; therefore, for parsimony, cohort was not included in the analyses.

A sequential modeling process was employed to test the hypotheses (Raudenbush & Bryk, 2002). Robust chi-square difference tests with scaling correction factors were used to

[1]A fixed effects approach was used where dummy codes for each school with multiple classrooms were added to the final models to account for school-level variance (McNeish & Wentzel, 2016). The hypothesized models did not change when the dummy codes were added; thus, to simplify the interpretation of the results, models without the dummy codes were reported.

compare each sequentially specified model (Satorra & Bentler, 2001). First, unconditional baseline models that contained no predictor variables were estimated to allow computation of intraclass correlation coefficients for each of the school adjustment outcome variables (i.e., TSR closeness, TSR conflict, school liking, and school avoidance). Second, the covariates were added[2]. Third, children's EC was added as a focal level-1 predictor. Fourth, classroom chaos was added as a focal level-2 predictor. In the fifth and final model, the interaction between children's EC and classroom chaos was estimated, while controlling for children's vocabulary, sex, age, Hispanic ethnicity, family SES, teacher's years of experience, and teacher's education. To help gauge the effect sizes of the interactions, we computed an estimate of the explanatory power of classroom chaos for predicting variation in the regression of each adjustment outcome on EC by comparing the slope variances at the classroom-level in the baseline model, without the interaction, to the model with the interaction. Pseudo R^2s were also computed at the child level and at the classroom level by comparing the residual variances at each level in the baseline model, without the interaction, to the model with the interaction (see Aguinis, Gottfredson, & Culpepper, 2013 for further discussion). Follow-up tests of simple slopes were conducted to further probe regression of each adjustment outcome on EC at high, average, and low levels of classroom chaos, as well as on classroom chaos at high, average, and low levels of EC, as recommended by Aiken and West (1991); these analyses were conducted to determine if the combination of low EC and high chaos would be associated with the poorest outcomes.

Results

Descriptive Statistics

Descriptive statistics and zero-order correlations for the focal study variables are presented in Table 1. The four school adjustments outcomes were considered normally distributed when skew was between −2 and 2 and kurtosis was between −7 and 7 (West, Finch, & Curran, 1995). TSR conflict and closeness and school liking were normally distributed, whereas avoidance had high positive skew of 2.77 (SD = .15) and kurtosis of 9.13 (SD = .29). Models including school avoidance as an outcome were analyzed using a log transformed and a non-transformed variable. Results did not differ across models; thus, for ease of interpretation, the models reported in this study include the non-transformed school avoidance variable. Children's EC was negatively associated with school avoidance and conflict in the TSR and was positively associated with school liking; however, EC was not associated with closeness in the TSR. In addition, classroom chaos was negatively related to school liking and closeness in the TSR and was positively related to conflict in the TSR; however, it was not related to school avoidance. In general, EC and classroom chaos were correlated in the expected direction with a number of the control variables. With the exception of the WJ-III PV test, which was consistently related to the outcomes, the control variables were not significantly correlated with the outcomes of interest.

[2]Models were also run with mothers' and fathers' education dummy coded, family income included as a separate covariate, and children's involvement in English as a Second Language classes, which did not change the results, thus for parsimony these variables were not included in the final models.

The results of the unconditional models were examined and ICCs were computed for the four outcome variables. The nonzero ICCs, .18 for TSR closeness, .04 for TSR conflict, .07 for school liking, and .03 for school avoidance, demonstrated systematic variation between classrooms, further supporting the need for a multilevel modeling approach to reduce the probability of Type I errors resulting from underestimation of standard errors (Kreft & de Leeuw, 1998).

The Main Effects of EC and Classroom Chaos on School Adjustment Outcomes

In the covariate-only models, the WJ-III PV test was consistently related to all outcomes, whereas age, sex, Hispanic, SES, and teacher's experience and teacher's education were infrequently related to the outcomes. This pattern is very similar to the results inclusive of all predictors displayed in Table 2. To avoid the risk of having a misspecified model due to exclusion of these theoretically relevant variables, the covariates were maintained in subsequent models. Table 2 shows results for the fully specified models for each of the four school adjustment outcomes and models without the interaction produced similar results for the main effects. When controlling for chaos, EC was significantly and positively associated with school liking and negatively associated with TSR conflict and school avoidance, but EC was not related to closeness. Additionally, classroom chaos was uniquely positively related to TSR conflict and negatively related to school liking, but was not significantly associated with TSR closeness and school avoidance.

The Moderating Role of Classroom Chaos on the Association Between EC and School Adjustment

To test the focal hypotheses, the interaction between EC and classroom chaos was examined for each of the outcomes. Wald tests for the EC by classroom chaos interactions were statistically significant in models for all four adjustment outcomes (see Table 2). Additionally, classroom chaos accounted for 27%, 86%, 50%, and <1% of the total between-class variance in slopes of regressions of closeness, conflict, liking, and avoidance, respectively, on EC. Pseudo R^2s indicated that the interaction term accounted for 1%, 2%, <1%, and <1% of the child level variance for closeness, conflict, liking, and avoidance, respectively, and accounted for <1% at the classroom level.

Simple slopes were tested by computing the regression coefficient for each outcome regressed on EC relative to classroom peers at the mean of classroom chaos and at one standard deviation above and below the mean (Aiken & West, 1991). For the TSR closeness outcome, the interaction coefficient was .15, indicating that the slope of the regression of closeness on EC relative to classroom peers increased by .15 for every 1 point increase in classroom chaos. As depicted in Figure 1, the slope between EC and closeness in the TSR was significant and positive in high chaos classrooms, but did not differ significantly from zero in low or medium chaos classrooms. For the TSR conflict outcome, the interaction coefficient was −.39, indicating that the slope of the regression of conflict on EC relative to classroom peers decreased by .39 for every 1 unit increase in classroom chaos. The negative relation between EC and TSR conflict was significant for all slopes but was most negative in high chaos classrooms (see Figure 2).

For the school liking outcome, the interaction coefficient was .09, indicating that the slope of the regression of closeness on EC relative to classroom peers increased by .09 for every 1 unit increase in classroom chaos. As depicted in Figure 3, the positive relation between EC and school liking was also stronger in higher chaos classrooms than in lower or medium chaos classrooms (but significantly different from zero for all values of chaos). Lastly, for the school avoidance outcome, the interaction coefficient was −.06, indicating that the slope of the regression of conflict on EC relative to classroom peers decreased by .06 for every 1 unit increase in classroom chaos. As depicted in Figure 4, the negative relation between EC and school avoidance was significant in medium and high, but not low, chaos classrooms.

In the previous analyses, children in high chaos classrooms appeared to be less adjusted to school, especially when children were low in EC relative to the average EC of their classroom peers. To specifically test this, post-hoc analyses were conducted to examine if low EC relative to the average EC of the class (*henceforth* referred to as low EC or high EC) was a significant risk factor in high chaos classrooms. To test this, the simple slopes of the interaction between chaos and EC were computed, specifying EC as the moderator (Johnson & Neyman, 1936; Kochanska, Kim, Barry, & Philibert, 2011). Simple slopes were tested by computing the regression coefficient for each outcome regressed on classroom chaos at the mean of EC and at one standard deviation above and below the mean of EC (Aiken & West, 1991). No simple slopes were significant at one standard deviation above the mean of EC. In contrast, at mean EC, chaos predicted lower school liking and higher TSR conflict. Additionally, as depicted in Figures 1 and 3, chaos was negatively related to close TSRs and school liking when EC was low. In addition, chaos was positively related TSR conflict when EC was low (see Figure 2). The association between chaos and school avoidance did not significantly differ from zero at any level of EC.

Discussion

The goal of this study was to determine the main and interactive effects of EC and classroom chaos on kindergartener's school adjustment. To achieve this goal, constructs assessed with multiple reporters were examined with a short-term longitudinal design. Children were studied during this developmental period because children's initial school success during their transition to formal schooling predicts later academic success (Early et al., 2001; Entwisle & Alexander, 1993; Rimm-Kaufman & Pianta, 2000); thus, it is important to understand the means through which children achieve early school success. This study found that high EC (relative to average classroom EC) predicted less conflict with teachers, and more school liking and less avoidance, and that low classroom chaos was related to less conflict with teachers and greater school liking. Evidence was also found in support of the T X E perspective. Specifically, the relations between EC and school adjustment were strongest in high chaos classrooms and the relation between classroom chaos and school adjustment was strongest when EC was low relative to average classroom EC, suggesting that a combination of low EC with high classroom chaos could result in poorer school adjustment.

Relations of Classroom Chaos with School Adjustment

Interestingly, evidence was found demonstrating that classroom chaos was related to TSR conflict, but not closeness. EC and TSR conflict were negatively related, whereas EC and TSR closeness were unrelated, which is consistent with the results found in previous research (Myers & Morris, 2009; Rudasill, 2011; Rudasill & Rimm-Kaufman, 2008; Swanson et al., 2012; Yang & Lamb, 2014). Classroom chaos is likely partially a function of challenging child behavior, resulting in an increase in behavior management that can contribute to TSR conflict (Buyse et al., 2008). Additionally, the noise and crowding contributing to chaos may thwart teachers' attempts to adequately communicate with children, resulting in more TSR conflict (Maxwell, 2010). Some research suggests that perceptions of chaos are related to individual's sensitivity to chaos in their environment (Wachs, 2013); thus, higher TSR conflict in chaotic classrooms may be due to teachers' sensitivity to noise. Chaos in the classroom may also further deplete teachers' energy resources, which could contribute to conflict with students. Associations between classroom chaos and TSR closeness may not have been found because there is likely large variability in closeness with students that teachers can feel with each student in chaotic classroom environments. In chaotic classrooms, teachers may have inconsistent relationships with their students, close at times and less close at other times.

Teachers' perceptions of chaos in their classroom were also negatively related to children's school liking but were unrelated to children's school avoidance. These results, similar to those found in previous studies (Ladd, Kochenderfer, & Coleman, 1997), demonstrate that the measures of school liking and avoidance may be tapping into different, but not necessarily opponent, processes. Aspects of a chaotic classroom environment, such as disorganization and noise, may lower the ability to engage in classroom activities and degrade children's positive attitudes about the school environment (Maxwell, 2010), but are not substantial enough for some children to want to actively avoid school. Similarly, children may be more likely to disclose dissatisfaction with school to parents rather than teachers; therefore, teachers may not be as good at reporting children's active avoidance of school as parents.

Relations of EC with School Adjustment: Direct Relations and Moderation

The results of this study support the premise that children's EC is related to optimal school adjustment (Eisenberg et al., 2010). Children lower in EC tend to behave in ways that are discrepant with school and classroom rules and, thus, tend to have more negative interactions with teachers involving poor behaviors (Rudasill & Rimm-Kaufman, 2008). In contrast, children who are higher in EC are less likely to exhibit negative behaviors that warrant attention from teachers; thus, depending on the classroom context, some teachers may have fewer opportunities to establish close relationships. Additionally, in this study higher EC relative to classroom peers was related to higher school liking and lower avoidance, which was consistent with a small body of literature (Iyer et al., 2010; Jahromi et al., 2013; Silva et al., 2011; Swanson et al., 2012; Valiente et al., 2007). EC helps to facilitate positive experiences in school (Fredricks et al., 2004), thereby increasing children's feelings of school liking while decreasing avoidance. Future studies might

consider examining the longitudinal and bidirectional associations between positive school experiences (e.g., higher achievement), EC, and school liking.

Of particular interest, classroom chaos consistently moderated the relations between EC and school adjustment. EC relative to classroom peers was positively related to TSR closeness in high, but not low and medium chaos classrooms. Furthermore, EC was most strongly and negatively related to conflict in high chaos classrooms, although it was also negatively related in low and medium chaos classrooms. Post-hoc analyses indicate that when children's EC was low relative to their classroom's average EC, high classroom chaos was associated with worse TSRs (i.e., low closeness and high conflict). These results suggest that low levels of EC, relative to average classroom EC, may be a risk factor in chaotic classrooms. Children low in EC, relative to the classroom average EC, may be less capable of regulating their behaviors in classrooms with high chaos, thus increasing emotional, behavioral, and social problems that hinder the TSR. Additionally, children whose EC is lower than the classroom average may behave in ways that create disruptions that interfere with a cooperative classroom environment (Blair, 2002). Thus, disruptive behaviors of low EC children may intensify classroom chaos, contributing to teachers' feelings of conflict and low closeness with low EC children.

Similar to the TSR results, EC relative to classroom peers was most strongly and positively associated with school liking in high chaos classrooms, although it was also positively related in low and medium chaos classrooms. Moreover, EC was significantly negatively related to school avoidance in high and medium chaos classrooms, but was not related in low chaos classrooms. Post-hoc analyses indicated that school liking was negatively related to chaos when children's EC was low relative to their classroom's average EC, but school avoidance was not related to chaos when children's EC was low relative to their classroom's average EC. These results suggest that when children's EC was low relative to their classroom's average EC and when they were in high chaos classes, children were less likely to enjoy being in school. In high chaos classrooms, the average level of EC is probably low; thus, the higher level of disorganization and noise in chaotic classrooms due, in part, to more low-EC children may be overwhelming, making it more difficult for low EC children to have enjoyable experiences in the classroom. Similarly, in high chaos classrooms, teachers may have less time to devote to low EC children, perhaps leaving them without the adequate support that they need to have positive academic and social encounters in the classroom. Overall these results also suggest that high EC may act in a protective capacity by buffering against the negative effects of chaos on their school adjustment.

Correlations Amongst Covariates and School Adjustment

Although most covariates included in this study were associated with school adjustment outcomes in the expected ways, two unexpected relations were found. Zero-order correlations indicated that higher teacher education and more teaching experience were related to higher classroom chaos. There are some plausible explanations for these associations. First, it is possible that teachers with more years of experience and education are more confident in their abilities to assess their classroom environment and they may be less concerned with social desirability (Kagan, 1992). Consequently, they may be more open

about the chaos within their classroom. Second, teachers with more experience may be more comfortable allowing chaos in their classrooms, in part because they know they can reestablish order and routine when needed, but also because they may also have lower sensitivity to noise and disorganization and higher tolerance of chaos. Some evidence suggests that the association between higher observed home chaos and parent's reports of chaos is moderated by parent's stimulus sensitivity, such that there is a stronger and positive association between observed chaos and parent reported chaos when parents were higher in stimulus sensitivity (Wachs, 2013). The positive relation between experience and chaos may indicate some selection criterion whereby teachers who are less sensitive to chaos remain in teaching.

Strengths and Limitations

This study has multiple strengths, which increases the contribution of the results to the literature. First, classroom observers and teachers reported on measures in this study. Second, unlike some previous studies, this study included statistical controls for class- and child-level variables. Third, the short-term longitudinal design, with the EC predictor assessed earlier in the school year than the outcomes, partially overcomes the limitations of a concurrent study.

Despite these strengths, there are limitations. One limitation of this study is the reliance on teachers' reports of classroom chaos. Scholars have noted that observations of classroom climate can provide a different and more objective perspective than teachers' reports (Ponitz et al., 2009). However, observations are also limited by the amount of time observers spend in the classroom, meaning observations are based on a limited number of hours and days. Additionally, observations can be time-intensive and costly. Other measures of chaos, such as using a dosimeter to measure noise and assessing the ratio of number of students to classroom space, may provide a cost-efficient objective way of assessing chaos in the classroom. In this study, teachers also reported the outcomes and it is possible that teachers who perceive a high level of chaos may also report that students are less adjusted to school. Future research in this area could benefit from using both objective and teachers' reports of chaos in the classroom.

A second limitation of this study is the inability to assess the stability of classroom chaos across the school year. In this study, classroom chaos was only measured in the spring. It is possible that changes in classroom chaos may be related to children's school adjustment. Additionally, without measuring classroom chaos in the fall, this study was unable to assess whether classroom chaos was associated with research assistants' inter-rater reliability on children's EC. Scholars assessing classroom chaos would benefit from measuring classroom chaos at multiple points throughout the school year to be able to assess stability and the association of chaos with the reliability of other measures.

Another limitation of this study is the small number of classrooms and proportion of children from low-income backgrounds. The number of classrooms used in this study is small but comparable to previous studies (Cameron, Connor, & Morrison, 2005; Nathanson, Rimm-Kaufman, & Brock, 2009; Ponitz et al., 2009; Wachs et al., 2004). Additionally, classroom chaos in the sample was relatively low ($M = 2.10$, $SD = .53$). Increased classroom

sample size would likely provide greater variability in classroom chaos, allowing for greater generalizability to other classrooms. A larger and more diverse sample of classrooms could enhance the results of future studies and allow for more associations between classroom chaos at various levels and children's outcomes. Additionally, the sample in this study was fairly representative of the population of parents in the United States in terms of mothers' and fathers' educational background (National Center for Education Statistics, 2015). These results, however, may not generalize to a lower SES sample. Future studies might consider examining the effects of classroom chaos in sample of lower SES families.

Furthermore, the three estimates of the EC and classroom chaos interaction we reported (i.e., interaction coefficient with Wald test, the proportion of total across-classroom variance in slopes explained by classroom chaos, and pseudo R^2) leave some questions regarding the practical significance of the interaction term. Aguinis et al. (2013) argued that each of these three estimates should be considered when interpreting cross-level interaction effects. Although the pseudo R^2*s* for child- and classroom-level for all four models suggest that the EC and classroom chaos interactions explained little variance in our outcomes, the pseudo R^2 disregards random effects (Aguinis et al., 2013). Thus, often the pseudo R^2 of cross-level interactions is very small (Snijders & Bosker, 2012). The results of the Wald tests and the proportion of total across-classroom variance in slopes explained by classroom chaos mostly corresponded with one another and suggest the classroom chaos and EC interaction meaningfully explains some variance in the four school adjustment outcomes, with the greatest effect of the EC by classroom chaos interaction observed for TSR conflict and the least effect observed for school avoidance. The across-classroom variance explained by classroom chaos is a metric that can be used to compare cross-level interaction effects across studies (Aguinis et al., 2013). It is important to consider the discrepancy between these three estimates when interpreting these results. Future researchers examining cross-level effects between child- and classroom-level variables should consider reporting all three estimates so that these results can be readily compared and the practical significance of these interactions can be better interpreted.

The last limitation of this study is the inability to fully capture the interdependence of average EC in the classroom and teachers' perceptions of classroom chaos. It is likely that a classroom with a larger number of children with low EC might be more challenging for a teacher to manage, thus increasing his or her perceptions of chaos. Further, individual child's EC relative to the average EC in his or her class may alter a teacher's perception of that student's adjustment. Models were also examined using grand mean centered EC as a predictor. These results, while similar, were weaker. In this study, classroom mean centered EC was used in the analyses because the research questions were focused on classroom context including how children's EC relative to their classmates' relates to their school adjustment (Enders & Tofigi, 2007). Although data on several children in each classroom were available in this study, because recruitment methods led to an average of 11 children per classroom, we are not able to fully capture the average level of EC in each classroom. Future studies examining the interplay between children's characteristics and classroom environment should consider the implications of sampling a larger percentage of children in each classroom.

Conclusions and Study Implications

Children's self-regulatory capacities, including EC, have been identified as requisite skills for school readiness (Blair, 2002). Thus, children with low EC may have a harder time adjusting to school than their higher EC counterparts. The results of this study suggest that high classroom chaos may hinder low EC children's potential to adjust and succeed in school. These results highlight the need to consider individual child characteristics as well as teachers' perceptions of their classroom environment as factors in children's transition to kindergarten and early educational experiences. It is possible that children who come to school lower in EC than their peers may have home environments that are high in chaos and may especially benefit from classrooms that are lower in chaos (Maxwell, 1996). Prevention efforts targeting temperament, classroom management, and classroom context have been successful at improving the classroom environment as well as child adjustment (Landry et al., 2014; McClowry, 1998; Raver et al., 2011). Consequently, by considering children's EC and the classroom environment during the transition to school, educators may be better poised to ensure optimal adjustment for all children.

References

Aguinis H, Gottfredson RK, Culpepper SA. Best-practice recommendations for estimating cross-level interaction effects using multilevel modeling. Journal of Management. 2013; 39(6):1490–1528. https://doi.org/10.1177/0149206313478188.

Aiken, LS., West, SG. Multiple Regression: Testing and Interpreting Interactions. SAGE Publications, Inc; 1991.

Baker JA. Contributions of teacher–child relationships to positive school adjustment during elementary school. Journal of School Psychology. 2006; 44(3):211–229. https://doi.org/10.1016/j.jsp.2006.02.002.

Bassok D, Latham S, Rorem A. Is kindergarten the new first grade? AERA Open. 2016; 2(1) 2332858415616358. https://doi.org/10.1177/2332858415616358.

Bauer DJ, Curran PJ. Probing interactions in fixed and multilevel regression: Inferential and graphical techniques. Multivariate Behavioral Research. 2005; 40(3):373–400. https://doi.org/10.1207/s15327906mbr4003_5. [PubMed: 26794689]

Birch SH, Ladd GW. The teacher-child relationship and children's early school adjustment. Journal of School Psychology. 1997; 35(1):61–79. https://doi.org/10.1016/S0022-4405(96)00029-5.

Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. American Psychologist. 2002; 57(2):111–127. https://doi.org/10.1037/0003-066X.57.2.111. [PubMed: 11899554]

Blair C, Raver CC. School readiness and self-regulation: A developmental psychobiological approach. Annual Review of Psychology. 2015; 66(1):711–731. https://doi.org/10.1146/annurev-psych-010814-015221.

Buhs ES, Ladd GW, Herald SL. Peer exclusion and victimization: Processes that mediate the relation between peer group rejection and children's classroom engagement and achievement? Journal of Educational Psychology. 2006; 98(1):1–13. https://doi.org/10.1037/0022-0663.98.1.1.

Bulotsky-Shearer RJ, Dominguez X, Bell ER. Preschool classroom behavioral context and school readiness outcomes for low-income children: A multilevel examination of child- and classroom-level influences. Journal of Educational Psychology. 2012; 104(2):421–438. https://doi.org/10.1037/a0026301.

Buyse E, Verschueren K, Doumen S, Van Damme J, Maes F. Classroom problem behavior and teacher-child relationships in kindergarten: The moderating role of classroom climate. Journal of School Psychology. 2008; 46(4):367–391. https://doi.org/10.1016/j.jsp.2007.06.009. [PubMed: 19083364]

Cameron CE, Connor CM, Morrison FJ. Effects of variation in teacher organization on classroom functioning. Journal of School Psychology. 2005; 43(1):61–85. https://doi.org/10.1016/j.jsp.2004.12.002.

Chen N, Deater-Deckard K, Bell MA. The role of temperament by family environment interactions in child maladjustment. Journal of Abnormal Child Psychology. 2014; 42(8):1251–1262. https://doi.org/10.1007/s10802-014-9872-y. [PubMed: 24691836]

Clark CA, Pritchard VE, Woodward LJ. Preschool executive functioning abilities predict early mathematics achievement. Developmental Psychology. 2010; 46(5):1176–1191. https://doi.org/10.1037/a0019672. [PubMed: 20822231]

Coie JD, Watt NF, West SG, David J, Asarnow JR, Markman HJ, … Long B. The science of prevention: A conceptual framework and some directions for a national research program. American Psychologist. 1993; 48(10):1013–1022. https://doi.org/10.1037/0003-066X.48.10.1013. [PubMed: 8256874]

Curby TW, Rudasill KM, Edwards T, Pérez-Edgar K. The role of classroom quality in ameliorating the academic and social risks associated with difficult temperament. School Psychology Quarterly. 2011; 26(2):175–188. https://doi.org/10.1037/a0023042.

Diaz, A., Eisenberg, N., Valiente, C., VanSchyndel, S., Spinrad, TL., Berger, R., … Southworth, J. Relations of positive and negative expressivity and effortful control to kindergarteners' student–teacher relationship, academic engagement, and externalizing problems at school. Journal of Research in Personality. 2015. https://doi.org/10.1016/j.jrp.2015.11.002

Early DM, Pianta RC, Taylor LC, Cox MJ. Transition practices: Findings from a national survey of kindergarten teachers. Early Childhood Education Journal. 2001; 28(3):199–206.

Eisenberg, N., Smith, CL., Spinrad, TL. Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood. In: Baumeister, RF., Vohs, KD., editors. Handbook of self-regulation: Research, theory, and applications. 2. New York, NY: Guilford; 2011. p. 263-283.

Eisenberg N, Valiente C, Eggum ND. Self-regulation and school readiness. Early Education and Development. 2010; 21(5):681–698. https://doi.org/10.1080/10409289.2010.497451. [PubMed: 21234283]

Enders CK, Tofighi D. Centering predictor variables in cross-sectional multilevel models: a new look at an old issue. Psychological Methods. 2007; 12(2):121–138. https://doi.org/10.1037/1082-989X.12.2.121. [PubMed: 17563168]

Entwisle DR, Alexander KL. Entry into school: The beginning school transition and educational stratification in the United States. Annual Review of Sociology. 1993; 19:401–423. https://doi.org/10.2307/2083394.

Figlio DN. Boys named sue: Disruptive children and their peers. Education Finance and Policy. 2007; 2(4):376–394. https://doi.org/10.1162/edfp.2007.2.4.376.

Fredricks JA, Blumenfeld PC, Paris AH. School engagement: Potential of the concept, state of the evidence. Review of Educational Research. 2004; 74(1):59–109. https://doi.org/10.2307/3516061.

Hamre BK, Pianta RC. Early teacher–child relationships and the trajectory of children's school outcomes through eighth grade. Child Development. 2001; 72(2):625–638. https://doi.org/10.1111/1467-8624.00301. [PubMed: 11333089]

Hamre BK, Pianta RC. Can instructional and emotional support in the first-grade classroom make a difference for children at risk of school failure? Child Development. 2005; 76(5):949–967. https://doi.org/10.1111/j.1467-8624.2005.00889.x. [PubMed: 16149994]

Hughes J, Kwok O. Influence of student-teacher and parent-teacher relationships on lower achieving readers' engagement and achievement in the primary grades. Journal of Educational Psychology. 2007; 99(1):39–51. https://doi.org/10.1037/0022-0663.99.1.39. [PubMed: 18084625]

Iyer RV, Kochenderfer-Ladd B, Eisenberg N, Thompson M. Peer victimization and effortful control: Relations to school engagement and academic achievement. Merrill-Palmer Quarterly. 2010; 56(3):361–387. https://doi.org/10.1353/mpq.0.0058. [PubMed: 23105166]

Jahromi LB, Bryce CI, Swanson J. The importance of self-regulation for the school and peer engagement of children with high-functioning autism. Research in Autism Spectrum Disorders. 2013; 7(2):235–246. https://doi.org/10.1016/j.rasd.2012.08.012.

Johnson PO, Neyman J. Tests of certain linear hypotheses and their application to some educational problems. Statistical Research Memoirs. 1936; 1:57–93.

Kagan DM. Implication of research on teacher belief. Educational Psychologist. 1992; 27(1):65–90. https://doi.org/10.1207/s15326985ep2701_6.

Kochanska G, Kim S, Barry RA, Philibert RA. Children's genotypes interact with maternal responsive care in predicting children's competence: Diathesis–stress or differential susceptibility? Development and Psychopathology. 2011; 23(02):605–616. https://doi.org/10.1017/S0954579411000071. [PubMed: 23786699]

Kreft, I., de Leeuw, J. Introducing Multilevel Modeling. Thousand Oaks, CA: Sage; 1998.

Ladd GW, Birch SH, Buhs ES. Children's social and scholastic lives in kindergarten: Related spheres of influence? Child Development. 1999; 70(6):1373. [PubMed: 10621962]

Ladd GW, Buhs ES, Seid M. Children's initial sentiments about kindergarten: Is school liking an antecedent of early classroom participation and achievement? Merrill-Palmer Quarterly. 2000; 46(2):255–79.

Ladd GW, Dinella LM. Continuity and change in early school engagement: Predictive of children's achievement trajectories from first to eighth grade? Journal of Educational Psychology. 2009; 101(1) https://doi.org/10.1037/a0013153.

Ladd GW, Kochenderfer BJ, Coleman CC. Classroom peer acceptance, friendship, and victimization: Destinct relation systems that contribute uniquely to children's school adjustment? Child Development. 1997; 68(6):1181–1197. https://doi.org/10.1111/j.1467-8624.1997.tb01993.x. [PubMed: 9418233]

Landry SH, Zucker TA, Taylor HB, Swank PR, Williams JM, Assel M. … School Readiness Research Consortium. Enhancing early child care quality and learning for toddlers at risk: the responsive early childhood program. Developmental Psychology. 2014; 50(2):526–541. https://doi.org/10.1037/a0033494. [PubMed: 23772822]

Lemery-Chalfant K, Kao K, Swann G, Goldsmith HH. Childhood temperament: Passive gene–environment correlation, gene–environment interaction, and the hidden importance of the family environment. Development and Psychopathology. 2013; 25(Special Issue 01):51–63. https://doi.org/10.1017/S0954579412000892. [PubMed: 23398752]

Loo C, Smetana J. The effects of crowding on the behavior and perception of 10-year-old boys. Environmental Psychology and Nonverbal Behavior. 1978; 2(4):226–249. https://doi.org/10.1007/BF01173771.

Loukas A, Murphy JL. Middle school student perceptions of school climate: Examining protective functions on subsequent adjustment problems. Journal of School Psychology. 2007; 45(3):293–309. https://doi.org/10.1016/j.jsp.2006.10.001.

Love, JM., Logue, ME., Trudeau, JV., Thayer, K. Final Report of the National Transition Study. Portsmouth, NH: RMC Research Corporation; 1992. Transitions to Kindergarten in American Schools; p. 1-127.Retrieved from http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED344693

Maxwell LE. Multiple effects of home and day care crowding. Journal of Environment and Behavior. 1996; 28(4) https://doi.org/10.1177/0013916596284004.

Maxwell, LE. Chaos outside the home: The school environment. In: Evans, GW., Wachs, TD., editors. Chaos and its influence on children's development: An ecological perspective. Washington, DC, US: American Psychological Association; 2010. p. 83-95.

McClowry SG. The science and art of using temperament as the basis for intervention. School Psychology Review. 1998; 27(4):551.

McNeish D, Wentzel KR. Accommodating small sample sizes in three-level models when the third level is incidental. Multivariate Behavioral Research. 2016; 0(0):1–16. https://doi.org/10.1080/00273171.2016.1262236.

Muthen, LK., Muthen, BO. MPlus user's guide. 7. Los Angeles, CA: Muthén & Muthén; 1998, 2012.

Myers SS, Morris AS. Examining associations between effortful control and teacher-child relationships in relation to Head Start socioemotional adjustment. Early Education and Development. 2009; 20(5):756–774. https://doi.org/10.1080/10409280802571244. [PubMed: 24000274]

Nathanson L, Rimm-Kaufman SE, Brock LL. Kindergarten adjustment difficulty: The contribution of children's effortful control and parental control. Early Education and Development. 2009; 20(5): 775–798. https://doi.org/10.1080/10409280802571236.

National Center for Education Statistics. The Condition of Education - Population Characteristics - Attainment - Parental Education. 2015 Jan. Retrieved May 17, 2017, from https://nces.ed.gov/programs/coe/indicator_saa.asp

Pianta, RC., Cox, MJ., editors. The transition to kindergarten. Baltimore: P.H: Brookes Pub; 1999.

Pianta RC, Steinberg MS, Rollins KB. The first two years of school: Teacher-child relationships and deflections in children's classroom adjustment. Development and Psychopathology. 1995; 7(02): 295–312. https://doi.org/10.1017/S0954579400006519.

Pianta RC, Stuhlman MW. Teacher-Child Relationships and Children's Success in the First Years of School. School Psychology Review. 2004; 33(3):444–458.

Ponitz CC, Rimm Kaufman SE, Brock LL, Nathanson L. Early adjustment, gender differences, and classroom organizational climate in first grade. The Elementary School Journal. 2009; 110(2):142–162. https://doi.org/10.1086/605470.

Ponitz CC, Rimm-Kaufman SE, Grimm KJ, Curby TW. Kindergarten classroom quality, behavioral engagement, and reading achievement. School Psychology Review. 2009; 38(1):102–120.

Portilla XA, Ballard PJ, Adler NE, Boyce WT, Obradovi J. An integrative view of school functioning: Transactions between self-regulation, school engagement, and teacher–child relationship quality. Child Development. 2014; 85(5):1915–1931. https://doi.org/10.1111/cdev.12259. [PubMed: 24916608]

Raudenbush, SW., Bryk, AS. Hierarchical linear models: Applications and data analysis methods. 2. Thousand Oaks: SAGE Publications, Inc; 2002.

Raver CC, Jones SM, Li-Grining C, Zhai F, Bub K, Pressler E. CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. Child Development. 2011; 82(1):362–378. https://doi.org/10.1111/j.1467-8624.2010.01561.x. [PubMed: 21291447]

Rimm-Kaufman SE, Pianta RC. An ecological perspective on the transition to kindergarten: A theoretical framework to guide empirical research. Journal of Applied Developmental Psychology. 2000; 21(5):491–511. https://doi.org/10.1016/s0193-3973(00)00051-4.

Rothbart MK, Ahadi SA, Hershey KL, Fisher P. Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. Child Development. 2001; 72(5):1394–1408. https://doi.org/10.1111/1467-8624.00355. [PubMed: 11699677]

Rothbart, MK., Bates, JE. Temperament. In: Eisenberg, N., editor. Handbook of child psychology. Vol. 3. New York, NY: Wiley; 2006. p. 99-166.

Rudasill KM. Child temperament, teacher–child interactions, and teacher–child relationships: A longitudinal investigation from first to third grade. Early Childhood Research Quarterly. 2011; 26(2):147–156. https://doi.org/10.1016/j.ecresq.2010.07.002.

Rudasill KM, Reio TG Jr, Stipanovic N, Taylor JE. A longitudinal study of student–teacher relationship quality, difficult temperament, and risky behavior from childhood to early adolescence. Journal of School Psychology. 2010; 48(5):389–412. https://doi.org/10.1016/j.jsp.2010.05.001. [PubMed: 20728689]

Rudasill KM, Rimm-Kaufman SE. Teacher–child relationship quality: The roles of child temperament and teacher–child interactions. Early Childhood Research Quarterly. 2008; 24(2):107–120. https://doi.org/10.1016/j.ecresq.2008.12.003.

Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. Psychometrika. 2001; 66(4):507–514. https://doi.org/10.1007/BF02296192.

Silva KM, Spinrad TL, Eisenberg N, Sulik MJ, Valiente C, Huerta S, … Taylor HB. Relations of children's effortful control and teacher-child relationship quality to school attitudes in a low-income sample. Early Education and Development. 2011; 22(3):434–460. https://doi.org/10.1080/10409289.2011.578046. [PubMed: 22573932]

Skibbe LE, Phillips BM, Day SL, Brophy-Herb HE, Connor CM. Children's early literacy growth in relation to classmates' self-regulation. Journal of Educational Psychology. 2012; 104(3):541–553. https://doi.org/10.1037/a0029153.

Snijders, TAB., Bosker, RJ. Multilevel analysis: An introduction to basic and advanced multilevel modeling. 2. Thousand Oaks, CA: SAGE Publications Ltd; 2012.

Sulik MJ, Huerta S, Zerr AA, Eisenberg N, Spinrad TL, Valiente C, … Taylor HB. The factor structure of effortful control and measurement invariance across ethnicity and sex in a high-risk sample. Journal of Psychopathology and Behavioral Assessment. 2009; 32(1):8–22. https://doi.org/10.1007/s10862-009-9164-y. [PubMed: 20593008]

Swanson J, Valiente C, Lemery-Chalfant K. Predicting academic achievement from cumulative home risk: The mediating roles of effortful control, academic relationships, and school avoidance. Merrill-Palmer Quarterly. 2012; 58(3):375–408. https://doi.org/10.1353/mpq.2012.0014.

Taylor ZE, Eisenberg N, Spinrad TL, Widaman KF. Longitudinal relations of intrusive parenting and effortful control to ego-resiliency during early childhood. Child Development. 2013; 84(4):1145–1151. https://doi.org/10.1111/cdev.12054. [PubMed: 23379965]

Valiente C, Lemery-Chalfant K, Castro KS. Children's effortful control and academic competence: Mediation through school liking. Merrill-Palmer Quarterly. 2007; 53(1):1–25. https://doi.org/10.1353/mpq.2007.0006.

Valiente C, Lemery-Chalfant K, Swanson J, Reiser M. Prediction of children's academic competence from their effortful control, relationships, and classroom participation. Journal of Educational Psychology. 2008; 100(1) https://doi.org/10.1037/0022-0663.100.1.67.

Valiente C, Swanson J, Lemery-Chalfant K. Kindergartners' temperament, classroom engagement, and student–teacher relationship: Moderation by effortful control. Social Development. 2012; 21(3):558–576. https://doi.org/10.1111/j.1467-9507.2011.00640.x.

Wachs TD. Relation of maternal personality to perceptions of environmental chaos in the home. Journal of Environmental Psychology. 2013; 34:1–9. https://doi.org/http://dx.doi.org.ezproxy1.lib.asu.edu/10.1016/j.jenvp.2012.11.003.

Wachs TD, Gurkas P, Kontos S. Predictors of preschool children's compliance behavior in early childhood classroom settings. Journal of Applied Developmental Psychology. 2004; 25(4):439–457. https://doi.org/10.1016/j.appdev.2004.06.003.

Wang Z, Deater-Deckard K, Petrill SA, Thompson LA. Externalizing problems, attention regulation, and household chaos: A longitudinal behavioral genetic study. Development and Psychopathology. 2012; 24(Special Issue 03):755–769. https://doi.org/10.1017/S0954579412000351. [PubMed: 22781853]

West, SG., Finch, JF., Curran, PJ. Structural equation modeling: Concepts, issues, and applications. Thousand Oaks, CA, US: Sage Publications, Inc; 1995. Structural equation models with nonnormal variables: Problems and remedies; p. 56-75.

Woodcock, RW., McGrew, KS., Mather, N. Woodcock-Johnson III tests of cognitive abilities. Riverside Pub; 2001.

Yang PJ, Lamb ME. Factors influencing classroom behavioral engagement during the first year at school. Applied Developmental Science. 2014; 18(4):189–200. https://doi.org/10.1080/10888691.2014.924710.

Yudron M, Jones SM, Raver CC. Implications of different methods for specifying classroom composition of externalizing behavior and its relationship to social–emotional outcomes. Early Childhood Research Quarterly. 2014; 29(4):682–691. https://doi.org/10.1016/j.ecresq.2014.07.007. [PubMed: 28275289]

Appendix

Table 3

Unstandardized Parameter Estimates for the Model Including the Interaction Between Grand Mean Centered EC and Classroom Chaos

	Teacher–student relationship		School attitudes	
	Closeness ***b* (*SE*)**	**Conflict** ***b* (*SE*)**	**Liking** ***b* (*SE*)**	**Avoidance** ***b* (*SE*)**
Intercept	4.48 (0.07)***	1.69 (0.08)***	2.81 (0.03)***	1.13 (0.03)***
Child-level fixed				
WJ-III PV	0.01 (0.00)**	−0.01 (0.00)***	0.00 (0.00)*	−0.01 (0.00)*
Age	0.04 (0.12)	0.30 (0.14)*	−0.02 (0.06)	−0.04 (0.04)
Sex	−0.17 (0.07)*	−0.07 (0.07)	−0.03 (0.03)	0.02 (0.04)
Hispanic	−0.01 (0.05)	−0.21 (0.10)*	0.03 (0.05)	−0.01 (0.03)
SES	−0.06 (0.06)	0.07 (0.08)	−0.01 (0.06)	0.02 (0.03)
EC	0.05 (0.05)	−0.50 (0.06)***	0.09 (0.06)	−0.05 (0.02)*
Child-level random				
Student-level variance	0.27 (0.05)***	0.45 (0.06)***	0.08 (0.02)***	0.06 (0.01)***
Classroom-level fixed				
Chaos	−0.17 (0.13)	0.25 (0.09)**	−0.13 (0.16)	0.00 (0.04)
Teacher experience	−0.01 (0.01)	−0.01 (0.01)	0.00 (0.02)	0.00 (0.00)
Teacher education	0.03 (0.09)	0.12 (0.10)	0.00 (0.07)	0.05 (0.02)*
EC X Chaos	0.13 (0.06)*	−0.37 (0.06)***	0.10 (0.05)*	−0.05 (0.03)
Classroom-level random				
Teacher experience variance	54.83 (8.16)***	54.82 (8.17)***	54.98 (8.27)***	54.81 (8.23)***
Teacher education variance	0.78 (0.12)***	0.77 (0.12)***	0.78 (0.12)***	0.77 (0.12)***
Chaos variance	0.28 (0.06)***	0.28 (0.06)***	0.28 (0.06)***	0.28 (0.06)***
Intercept variance	0.06 (0.02)*	0.01 (0.02)	0.00 (0.02)	0.00 (0.00)
EC Slope variance	0.01 (0.01)	0.01 (0.04)	0.00 (0.02)	0.01 (0.00)*
Simple Slopes				
High chaos	0.12 (0.07)+	−0.69 (0.07)***	0.14 (0.08)+	
Medium chaos	0.05 (0.05)	−0.50 (0.06)***	0.09 (0.06)	
Low chaos	−0.02 (0.04)	−0.30 (0.06)***	0.04 (0.04)	

Note. For all models $N = 286$. Student's age is in years. Student sex is coded as 0 = female, 1 = male; Hispanic is coded as 0 = non-Hispanic, 1 = Hispanic. SES = Socioeconomic status; WJ-III PV = Woodcock Johnson III Picture Vocabulary; EC = Effortful Control; Chaos = Classroom chaos; Simple slopes are only reported for models with a significant interaction.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Highlights

- Effortful control is related to school adjustment at high classroom chaos.
- Classroom chaos is related to school adjustment at low effortful control relative to average effortful control of the class.
- Combined effort control and classroom chaos may relate to school adjustment.

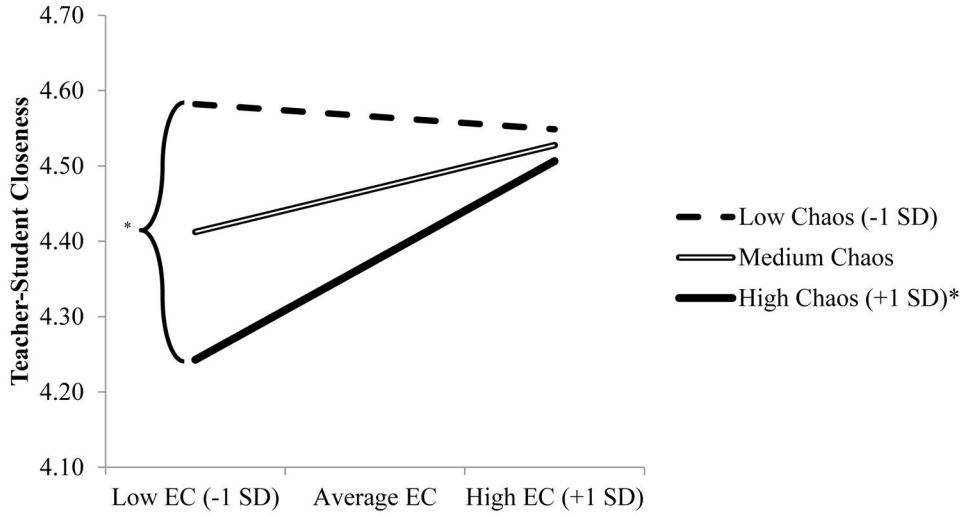

Figure 1.

Moderating effect of classroom chaos on the relation between effortful control (EC) and teacher–student closeness. The figure depicts the simple slopes for low ($b = -0.02$ ($SE = .05$), $p = .62$), medium ($b = .06$ ($SE = .05$), $p = .20$), and high ($b = .14$ ($SE = .06$), $p = .03$) classroom chaos. Bracket indicates where the simple slope was significant when EC was the moderator (low EC: $b = -0.32$ ($SE = .15$), $p = .04$, mean EC: $b = -0.18$ ($SE = .14$), $p = .19$, high EC: $b = -0.04$ ($SE = .14$), $p = .81$). *$p < .05$.

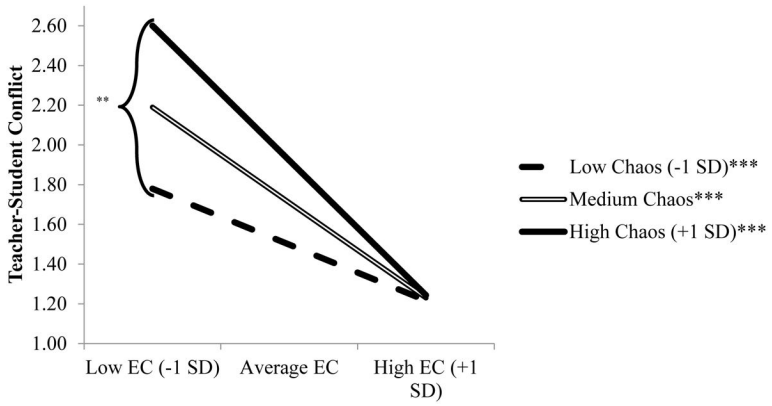

Figure 2.

Moderating effect of classroom chaos on the relation between effortful control (EC) and teacher–student conflict. The figure depicts the simple slopes for low ($b = -0.30$ ($SE = .05$), $p < 0.001$), medium ($b = -0.50$ ($SE = .05$), $p < 0.001$), and high ($b = -0.71$ ($SE = .07$), $p < 0.001$) classroom chaos. Bracket indicates where the simple slope was significant when EC was the moderator (low EC: $b = .78$ ($SE = .13$), $p < 0.001$, mean EC: $b = .40$ ($SE = .11$), $p < 0.001$, high EC: $b = .03$ ($SE = .14$), $p = .84$). ***$p < .001$.

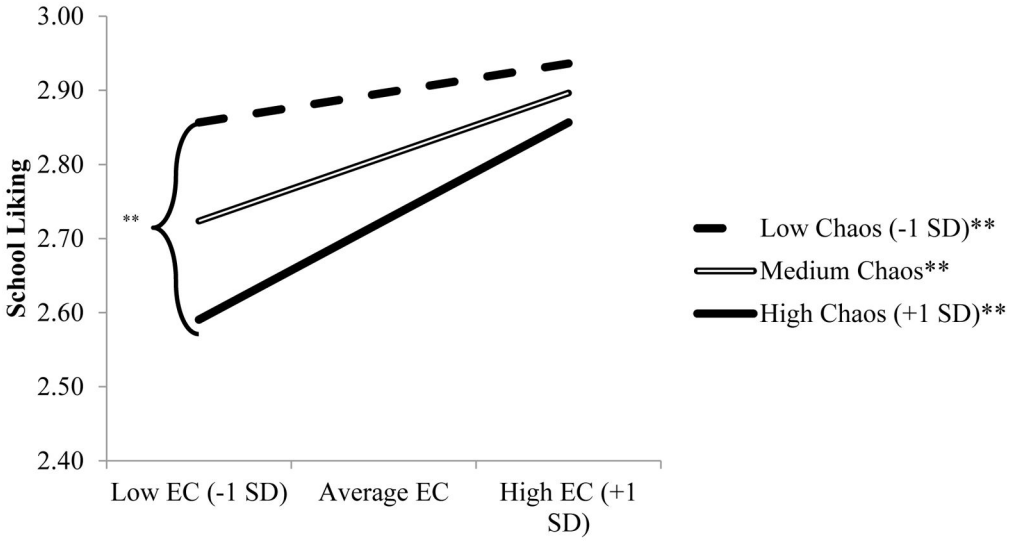

Figure 3.

Moderating effect of classroom chaos on the relation between effortful control (EC) and school liking. The figure depicts the simple slopes for low ($b = .04$ ($SE = .02$), $p < 0.01$), medium ($b = .09$ ($SE = .03$), $p < 0.01$), and high ($b = .14$ ($SE = .05$), $p < 0.01$) classroom chaos. Bracket indicates where the simple slope was significant when EC was the moderator (low EC: $b = -0.25$ ($SE = .04$), $p < 0.000$, mean EC: $b = -0.16$ ($SE = .03$), $p < 0.001$, high EC: $b = -0.07$ ($SE = .06$), $p = .19$). $^{**}p < .01$.

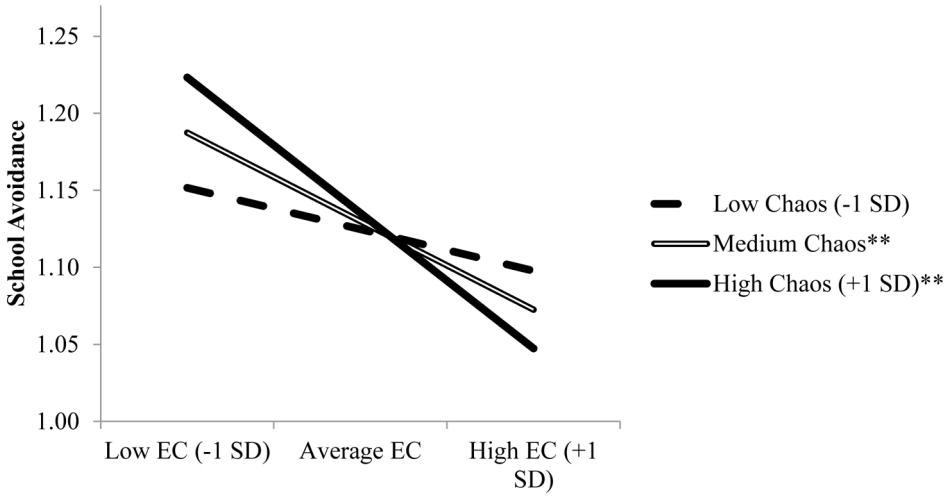

Figure 4.

Moderating effect of classroom chaos on the relation between EC and school avoidance. The figure depicts the simple slopes for low ($b = -0.03$ ($SE = .02$), $p = .17$), medium ($b = -0.06$ ($SE = .02$), $p = .01$), high ($b = -0.09$ ($SE = .03$), $p < 0.01$) classroom chaos. Bracket indicates where the simple slope was significant when EC was the moderator (low EC: $b = .07$ ($SE = .06$), $p = .23$, mean EC: $b = .01$ ($SE = .04$), $p = .71$, high EC: $b = -0.04$ ($SE = .04$), $p = .29$). **$p < .01$.

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Table 1

Descriptive Statistics and Correlations for Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Years teaching	-												
2. Teacher's education	0.82***	-											
3. Child age	0.00	−0.05	-										
4. Child sex	−0.02	0.01	0.11†	-									
5. Hispanic	0.00	−0.03	0.12†	−0.11†	-								
6. SES	−0.18**	−0.05	−0.11†	0.12*	−0.36***	-							
7. WJ-III PV	−0.03	0.08	−0.02	0.19***	−0.40***	0.53***	-						
8. EC	0.13*	0.16**	0.07	−0.10†	−0.04	0.11†	0.13*	-					
9. Classroom Chaos	0.37***	0.30***	−0.04	−0.02	0.24***	−0.29***	−0.20***	−0.09	-				
10. TSR: Closeness	−0.12*	−0.10	0.04	−0.12*	−0.05	−0.02	0.12*	0.10	−0.20***	-			
11. TSR: Conflict	0.00	0.01	0.04	0.02	−0.02	−0.04	−0.17**	−0.53***	0.20***	−0.40***	-		
12. School liking	−0.05	−0.02	0.01	−0.05	−0.07	0.11†	0.21***	0.32***	−0.27***	0.46***	−0.51***	-	
13. School avoidance	0.04	0.07	−0.05	0.04	0.04	−0.04	−0.18**	−0.22***	0.05	−0.07	0.24***	−0.52***	-
n	279	279	283	286	270	286	282	286	284	271	272	272	272
Min	1.00	1.00	4.27	0.00	0.00	−1.83	417.00	1.43	1.07	1.88	1.00	1.29	1.00
Max	20.00	3.00	6.81	1.00	1.00	1.15	513.00	6.89	3.13	5.00	5.00	3.00	2.83
Mean	8.27	1.62	5.48	0.48	0.57	−0.10	469.15	5.31	2.10	4.37	1.55	2.81	1.14
SD	7.32	0.87	0.35	0.50	0.50	0.90	12.03	0.96	0.53	0.62	0.87	0.32	0.28

Note. Child's age is in years. Child sex is coded as 0 = female, 1 = male; Hispanic is coded as 0 = non-Hispanic, 1 = Hispanic. SES = Socioeconomic status; WJ-III PV = Woodcock Johnson III Picture Vocabulary; EC = Effortful Control; TSR = Teacher–Student Relationship.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2

Unstandardized Parameter Estimates for the Final Model Including the Interaction between EC and Classroom Chaos

	Teacher–student relationship		School attitudes	
	Closeness ***b (SE)***	**Conflict** ***b (SE)***	**Liking** ***b (SE)***	**Avoidance** ***b (SE)***
Intercept	4.47 (0.07)***	1.71 (0.09)***	2.81 (0.03)***	1.13 (0.03)***
Child-level fixed				
WJ-III PV	0.01 (<0.01)**	−0.01 (<0.01)***	<0.01 (<0.01)*	<0.01 (<0.01)*
Age	0.04 (0.12)	0.30 (0.14)*	−0.02 (0.06)	−0.04 (0.04)
Sex	−0.16 (0.07)*	−0.05 (0.07)	−0.04 (0.03)	0.02 (0.04)
Hispanic	<0.01 (0.05)	−0.24 (0.10)*	0.03 (0.05)	−0.01 (0.03)
SES	−0.06 (0.05)	0.05 (0.05)	−0.01 (0.02)	0.02 (0.03)
EC	0.06 (0.05)	−0.50 (0.05)***	0.09 (0.03)***	−0.06 (0.02)**
Child-level random				
Student-level variance	0.27 (0.05)***	0.45 (0.06)***	0.08 (0.02)***	0.06 (0.01)***
Classroom-level fixed				
Chaos	−0.18 (0.14)	0.40 (0.12)***	−0.16 (0.03)***	0.01 (0.04)
Teacher experience	−0.01 (0.01)	−0.02 (0.01)	<0.01 (<0.01)	−0.01 (<0.01)
Teacher education	0.01 (0.09)	0.07 (0.07)	0.01 (0.02)	0.05 (0.02)*
EC X Chaos	0.15 (0.06)*	−0.39 (0.08)***	0.09 (0.04)*	−0.06 (0.03)*
Classroom-level random				
Teacher experience variance	54.88 (8.19)***	55.39 (8.43)***	55.27 (8.30)***	55.07 (8.29)***
Teacher education variance	0.78 (0.12)***	0.78 (0.12)***	0.78 (0.12)***	0.78 (0.12)***
Chaos variance	0.28 (0.06)***	0.28 (0.06)***	0.28 (0.06)***	0.28 (0.06)***
Intercept variance	0.06 (0.02)*	0.02 (0.02)	<0.01 (<0.01)	<0.01 (<0.01)
EC Slope variance	0.01 (0.01)	<0.01 (0.02)	<0.01 (<0.01)	0.01 (<0.01)*

Note. For all models $N = 286$. Student's age is in years. Student sex is coded as 0 = female, 1 = male; Hispanic is coded as 0 = non-Hispanic, 1 = Hispanic. SES = Socioeconomic status; WJ-III PV = Woodcock Johnson III Picture Vocabulary; EC = Effortful Control; Chaos = Classroom chaos.

* $p < .05$.

** $p < .01$.

*** $p < .001$.