Classroom interactions, dyadic teacher–child relationships, and self–regulation in socially disadvantaged young children

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Abstract

This study examined the quality of the classroom climate and dyadic teacher–child relationships as predictors of self–regulation in a sample of socially disadvantaged preschool children (*N* = 206; 52% boys). Children's self–regulation was observed in

preschool at the beginning and at the end of the school year. At the middle of the preschool year, classroom observations of interactions were conducted by trained observers and teachers rated the quality of dyadic teacher–child relationships. Results from multilevel analyses revealed that teacher–child closeness predicted improvements in observed self–regulation skills. Children showed larger gains in self–regulation when they experienced closer teacher–child relationships. Moreover, a moderating effect between classroom instructional quality and observed self–regulation was found such that children with low initial self–regulation skills benefit the most from classrooms with higher classroom quality. Findings have implications for understanding the role of classroom social processes on the development of self–regulation.

Keywords: Teacher-child relationships; Classroom interactions; Self-regulation; Early education and care; Socially disadvantaged children

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There has been a recent increase in universal early childhood services in many Western countries, based on a vast literature highlighting the preschool years as a critical period for the development of social, language and cognitive skills (Leseman, 2009). Increasing numbers of children are currently attending preschool throughout many countries (OECD, 2013). However, many children, especially from socially disadvantaged backgrounds, start school lacking critical skills for a successful transition to school, namely self–regulation (Blair & Razza, 2007). A growing number of studies have shown that self–regulation is linked to academic skills, such as literacy and mathematics, and to social competence (Blair & Razza, 2007; McClelland et al., 2007). Thus, identifying specific aspects of the environment that can contribute to the development of self–regulation becomes of crucial importance. An emergent literature suggests that emotionally–close, sensitive, well–organized, and cognitively stimulating interactions in the classroom are related to young children's development of social and academic outcomes (Burchinal, Peisner–Feinberg, Bryant, & Clifford, 2000; Hamre & Pianta, 2005). Classroom process quality refers to the quality of children's direct experiences and includes both the quality of teacher-child relationships and the overall classroom climate (Howes et al., 2008). To date, however, the links between classroom process quality and children's development of self–regulation have been largely overlooked. The current study investigates whether different facets of classroom process quality, namely the quality of individual–level teacher–child interactions and the classroom environment predict the development of self–regulation in a socially disadvantaged sample of preschool children.

Self–regulation in young children

Self–regulation refers broadly to children's ability to deliberately modulate thoughts, emotions, and behavior in response to a given situation (McClelland & Cameron, 2012). Recent evidence suggests that, in early childhood, self–regulation is best described as a unitary, integrative construct (Wiebe, Espy, & Charak, 2008; Willoughby, Wirth, & Blair, 2012). In line with this view, in this study, we focus on the integrative nature of self–regulation and use a direct measure to tap a set of interrelated skills, including sustaining attention (attention), remembering instructions (working memory), and stopping inappropriate behaviors (inhibitory control). These skills, in combination, are particularly important to successfully navigate in the classroom setting and are likely to be influenced by relational and interactive processes within the classroom (McClelland & Cameron, 2012; Ponitz, McClelland, Matthews, & Morrison, 2009).

A substantial developmental growth in self–regulation is observed between the ages of 3 and 5 years, and is closely associated with the development of neural networks in prefrontal cortex during the early years (Welsh, Nix, Blair, Bierman, & Nelson, 2010; Willoughby et al., 2012). The preschool years are, thus, a particularly important period for promoting self–regulation, especially for children who may be at risk for lower self–regulation skills, as is the case of children who grow up under conditions of socioeconomic disadvantage (Mezzacappa, 2004; Noble, Norman, & Farah, 2005). Research has also suggested that emotionally supportive and cognitively stimulating interactions with caregivers can potentially counterbalance the detrimental effects of social disadvantage (Bernier, Carlson, & Whipple, 2010; Chang, Olson, Sameroff, & Sexton, 2011). In line with this view, randomized control studies suggest that classroom interventions can support gains in self–regulation (Raver et al., 2011), but the links between typical, daily preschool experiences and the development of self–regulation have not been systematically examined.

High-quality direct experiences in the classroom, referred to as process quality, may affect children's self-regulation at two levels: (a) Classroom–level quality processes, including the overall emotional, organizational and instructional climate; (b) individual–level quality processes, referring to perceived quality of the relationship between the teacher and the child which can provide nuanced information relative to a particular child's experience. In this study we consider these two core dimensions of process quality in terms of their prediction of self–regulation skills.

Individual–level quality processes and self-regulation

A vast body of research suggests that teachers' perceptions of positive teacher–child relationships consisting of high levels of warmth, closeness, and reciprocal support are associated with children's development across social and academic domains, including positive beliefs, motivation, and academic performance in the early grades (Buyse, Verschueren, Verachtert, Van Damme, & Maes, 2008; Hughes & Kwok, 2006). In contrast, perceived negative teacher–child relationships, characterized by high conflict and disagreement between the child and teacher, have been shown to act as risk factors for children's school success (Buyse et al., 2008; Hamre & Pianta, 2001). Less work has directly examined associations between perceived teacher-child relationships and the development of self-regulation. One recent study showed that conflictual relationships were likely to undermine children's self-regulation skills over the elementary school years (Berry, 2012). This study, however, did not consider the role of supportive teacher-child relationships on self-regulation. In addition, to our knowledge, the effects of teacher-child relationships on self-regulation for preschool-aged children have not been considered directly. Emotionally–close teacher–child relationship are likely to serve as external supports that help children to organize their thinking and behavior (Berry, 2012; Blair & Diamond, 2008). As children enter preschool, warm relationships, marked by respect

and care, may support children to be self–directed and autonomous by providing them the emotional resource upon which children can rely as they learn to be in the classroom (Rudasill & Rimm–Kaufman, 2009). Supportive relationships are also likely to elicit positive moods that promote effective problem solving and help children to sustain their attention (Blair, 2002). Therefore, the current study extends existing studies by examining the effects of both conflict and closeness on young children's self-regulation skills.

Classroom–level quality processes and children's self-regulation

High-quality classroom processes include warm, well–managed, and cognitively stimulating interactions that are intentionally directed to promote children's learning and development within a positive social classroom climate (Hamre & Pianta, 2005; Howes et al., 2008; Mashburn et al., 2008). These classroom–level quality processes have shown to predict gains in children's literacy, language, and cognitive development (Howes et al., 2008, Mashburn et al., 2008), with some studies suggesting that the effects are more pronounced for high–risk children (Burchinal et al., 2000; Hamre & Pianta, 2005).

Recent research has attempted to differentiate classroom quality into distinct dimensions, namely emotional, organizational, and instructional support, and to explore its differential effects on children's outcomes (Downer, Sabol, & Hamre, 2010; Hamre, Hatfield, Pianta, & Jamil, 2014; Rimm–Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Conceptually, it has been suggested that contexts that provide better organizational support, where teachers use proactive approaches to monitor children's behavior, establish predictable routines in the classroom, and provide activities that are inherently interesting, are important for children's self–regulation (Downer et al., 2010, Hamre et al., 2014; Rimm–Kaufman et al., 2009). But other classroom features, specifically, warm, positive classroom interactions may

provide the foundation for children's autonomy and responsibility and thus can also be important for self–regulation skills (Blair & Diamond, 2008; Downer et al., 2010). Similarly, children's reciprocal and active involvement with teachers in interesting, challenging and thought–provoking activities may create important opportunities for language exchanges and scaffolding which may contribute to active engagement and to improving attention shifting, focusing, and inhibitory control skills, all of which are components of self–regulation (Rimm–Kaufman et al., 2009).

Empirically, the links between classroom quality and self-regulation have been explored only in few studies. In one recent study, Fuhs, Farran, and Nesbitt (2013) found that children made more gains in self-regulation skills in classrooms where teachers provided high levels of emotional climate, where activities were well-enough managed and where teachers asked more open-ended questions. In contrast, results from one study in kindergarten showed that organizational support, rather than either emotional or instructional support, had a stronger association with self-regulation skills (Rimm-Kaufman et al., 2009). These mixed findings suggest the need for further research in this area. Importantly, these studies did not examine the moderating role of individual child characteristics.

Interaction of classroom quality variables and child characteristics

Recent research suggests that the effects of classroom process quality may vary as a function of child characteristics, namely self-regulation difficulties and gender. For instance, Liew, Chen, and Hughes (2010) found that positive individual-level teacher–child relationships served as a compensatory factor so that children with low initial self-regulation skills performed just as well academically as those with high self-regulation when paired with a positive and supportive teacher. Thus, the influence of high-quality relationships on gains in self–regulation skills may depend on children's initial levels of self–regulation (Rudasill & Rimm–Kaufman, 2009),

making it important to investigate moderating effects. Similarly, prior research has suggested that the paths linking early relationships and behavioral adjustment may be different for boys and girls (Chang et al., 2011, Hamre & Pianta, 2001). Two conflicting perspectives – gender role socialization and academic risk – have been considered. According to gender role socialization perspective, girls would benefit more than boys from close relationships with teachers because girls are expected to have greater intimacy and affiliation in social relationships (Roorda, Koomen, Spilt, & Oort, 2011). In contrast, according to the academic risk perspective, social relationships would have more impact for boys because boys are at greater risk for school failure than girls (Hamre & Pianta, 2001). This study builds on this prior work and examines how process quality interacts with initial levels of self-regulation and gender to contribute to self-regulation skills at the end of the year. By investigating the main and moderating effects and by combining individual– and classroom–level dimensions of process quality, we contribute to a more comprehensive model of potential process quality contributors to self–regulation.

The present study

In the current study, we examined the extent to which specific classroom processes contributed to gains in young children's self–regulation skills across the preschool year in an economically disadvantaged sample. In particular, we were interested in determining the influences of two core dimensions of classroom processes: classroom–level dimensions of quality, and dyadic teacher–child relationships. We hypothesized that both levels of classroom quality would make independent contributions to gains in self-regulation.

An additional goal of this study was to investigate possible moderators, including varying levels of initial self-regulation skills and child gender. Based on prior research that suggests that process quality operates differently for children with

varying levels of self-regulation (Liew et al., 2010), we tested whether positive effects of classroom and individual social processes on self-regulation were moderated by levels of self-regulation at the beginning of the preschool year. We expected the effects of process quality to be more pronounced for children with low levels of self-regulation. Additionally, we also examined gender differences in the associations between process quality and self-regulation. In line with the academic risk perspective (Hamre & Pianta, 2001; Roorda et al., 2011), we expected that the effects of the quality of interactions would be stronger for boys.

Method

Participants

Participants in this study were 206 young children (52% boys) and their preschool teachers from socially disadvantaged areas situated in the large metropolitan area of Porto, Portugal. Children's mean age was 4 years and 11 months (*SD* = 0.71, range = 36–78 months) at the beginning of the school year. Children were enrolled in 47 classrooms under the Priority Intervention Territories Program (TEIP). The TEIP program is a national funded action that targets public schools serving high–risk populations that are at risk for poverty and social exclusion. The program intends to improve the quality of learning experiences, promote student's academic performance and decrease early school leaving, by allocating more economic and human resources, such as more teachers, assistants and specialized staff (e.g. social workers, social educators, psychologists), as well as external experts who advise schools based on their needs. Nevertheless, teachers in this program follow the national curriculum guidelines, and the activities and materials are similar to the other preschool classrooms. Teachers also have the same initial training. Teachers in Portugal are required to hold the degree of Bachelor in Early Childhood, which involves the completion of a three years training program in either a teacher training

college or a university. Preschool in Portugal is part of the national education system for children aged 3 to 5 and, although not compulsory, the attendance rate is relatively high at 74% (Instituto Nacional de Estatística [INE], 2012).

Classroom sizes ranged from 15 to 25 (M = 21.75; SD = 3.14) and in most classrooms (59%), there were two adults assisting the teacher. In each classroom, five children were randomly selected, with the majority of classrooms (83%) having at least four participating children. Preschool teachers (100% women) had on average 26 years of teaching experience (SD = 6.35). All teachers had a professional certificate in Education.

Regarding family background, 47% of the mothers had at most nine years of schooling. The percentage of mothers attending secondary school (12 years) was 24%, which is below the 32% for the national educational levels (INE, 2012; OECD, 2013). Regarding the household monthly income, 36% of the families had incomes below the National Minimum Wage (NMW), which is equivalent to 485€ a month, and 5820€ a year. This rate is well above the national rate of 13,5% of families with incomes below the NMW. The NMW (equivalent to $4.35 USD per hour) is slightly above half of the federal minimum wage in the United States of $7.25 USD. Concerning the current professional situation, 29% of the mothers were unemployed, which again is a considerably higher rate than the national rate of 13%.

Procedure

Data were collected across the preschool year (in Portugal, the school year runs from September to June). Before data collection, the procedures of this study were approved by the national ethical committee, and written consents from teachers, and parents were obtained. Children's self–regulation and vocabulary were both assessed at the beginning of the preschool year (from October to December 2013). Research assistants administered the tasks individually at the child's preschool center,

in a quiet room. At the middle of the school year (from January to April 2014), live classroom observations of teacher–child interactions were conducted by trained observers. This time of the year was selected because, although scores are relatively stable across the year (Pianta, La Paro, & Hamre, 2008), by this time of the preschool year, teachers have already set classroom rules and routines and, thus, this period represents typical practice more accurately than the first or last months of the preschool year. Observers conducted four 20 minutes observation cycles using the CLASS (Pianta et al., 2008), with observations lasting approximately 2–3 hours, starting at the beginning of the classroom day. Teachers rated the quality of teacher–child relationship at the middle of the school year (from January to April 2014). Children's self–regulation was again assessed at the end of the preschool year (from May to June 2014).

Measures

Direct observation of self–regulation. Self–regulation was assessed with Head–Toes–Knees–Shoulders task (HTKS; Ponitz et al., 2009). The HTKS integrates executive function processes such as attention, working memory and inhibitory control in a short game (McClelland & Cameron, 2012). This measure was designed to assess the integrative nature of self–regulation in an ecologically valid manner covering aspects of self–regulation similar to the behaviors required from children in the classroom context (McClelland & Cameron, 2012; Ponitz et al., 2009). In the task, children are asked to do the opposite from what the instructor says. The task includes two parts involving paired rules: a head–toes section (10 items), in which children are required to touch their toes when told to touch their head and vice versa, and the head–toes–knees–shoulders section (10 items), in which in addition to the head–toes command, the knees–shoulders paired command is added and children are additionally instructed to touch their knees when told to touch their shoulders and vice

versa. Before each part, four practice trials with feedback are given to children. The task requires 5–7 minutes to administer. Scores range from 0 to 40, with scores of 0 (*incorrect*), 1 (*self–correct*), or 2 (*correct*) for each item. The task is being increasingly used and has been found to be reliable in diverse samples and across societies, namely in the USA, Asia, and Europe (Fuhs, Farran, & Nesbitt, 2013; McClelland & Cameron, 2012; von Suchodoletz et al., 2012; Wanless et al., 2011). Predictive validity of the task has also been established based on positive associations with academic outcomes (von Suchodoletz et al., 2012). In addition, this measure has been found to be associated with preschool classroom processes (Fuhs et al., 2013). In the current study, Cronbach's alpha was adequate at each measurement occasion, respectively .94 and .93, at first and last time points, computed based on the 20 test items. Regarding scoring consistency across examiners on HTKS total score, there were no significant differences between examiners in children's HTKS scores, $F(3,173) = 1.90$, $p = .131$ after controlling for child age.

Dyadic teacher–child relationship quality. To assess teachers' perceptions of their relationships with a specific child we used the conflict and closeness subscales of the Student-Teacher-Relationship-Scale (STRS, Pianta, 2001). The conflict subscale includes eight items that describe teacher–perceived negativity and discordance with the child. A sample item includes "This child and I always seem to be struggling with each other". The closeness subscale includes seven items that indicate teacher perceived warmth and open communication with the child. A sample item includes "This child openly shares his/her feelings and experiences with me". Teachers rate each item on a Likert–type scale ranging from 1 (*definitely does not apply*) to 5 (*definitely applies*). This measure has been widely used and evidence for its reliability and validity has been reported across different samples (Doumen, Koomen, Buyse, Wouters, & Verschueren, 2012; Hamre & Pianta, 2001). Results of

confirmatory factor analysis for this sample showed that a two–factor model fitted the data adequately, $\chi 2$ (42) = 68.29, $p < .01$, RMSEA = .056, CFI = .927, after excluding two items from the closeness scale that had low factor loadings: “This child is uncomfortable with physical affection or touch from me (reversed)” and “This child tries to please me”. Internal consistency was adequate for both scales, respectively, for conflict (eight items) and closeness (five items), Cronbach’s $\alpha = .83$ and $\alpha = .76$.

Classroom environment. The quality of interactions between teachers and children in the classroom were observed with the Classroom Assessment Scoring System (CLASS; Pianta et al., 2008). The CLASS is an observational measure that assesses the social and emotional climate, as well as the instructional support provided in classrooms. Observers rated the classroom using a 7–point Likert on 10 distinct dimensions that are grouped in three domains (a) Emotional support considers the enthusiasm, enjoyment and the extent to which teachers provide comfort to children; (b) Classroom organization considers teacher’s ability to use effective methods to monitor behavior and how well teachers maximize time spent in learning activities; (c) Instructional support considers the strategies used to promote children’s higher order thinking skills and creativity, the degree to which teachers' feedback extends children's learning and the use of language–stimulation techniques.

The CLASS has been widely used in the United States and in several European countries, and its validity has been established based on positive associations with other quality measures (e.g., Early Childhood Environment Rating Scale; Harms, Clifford, & Cryer, 1998), as well as based on positive associations with children’s social and academic development (Cadima, Leal, & Burchinal, 2010; Mashburn et al., 2008; Pakarinen et al., 2010). However, although the three–factor solution has been shown to provide the best fit to the data in some studies (Hamre et al., 2014; Pakarinen et al., 2010), very high correlations among the three domains

have been reported (Pakarinen et al., 2010), which is particularly problematic when trying to examine the extent to which each domain is related to specific outcomes (Hamre et al., 2014). In this study, Emotional Support and Classroom Organization domains were strongly correlated to each other, $r = .80$, raising multicollinearity concerns. Furthermore, results from Confirmatory Factor Analyses showed that the two–factor model, in which Emotional Support and Classroom Organization dimensions were combined, provided an adequate fit to the data, $\chi2(64) = 135.14$, $p < .001$, CFI = .905, RMSEA = .078, and the decrease in model fit from the original three–factor solution was non–statistically significant, $\Delta\chi2(4) = 8.58$, *ns*. Moreover, the two-factor model provided a better fit to the data compared to the one-factor model, $\Delta\chi2(2) = 195.39$, $p < .001$. Based on these results, after averaging scores across the four observation cycles, two domains were used in this study: the Emotional/organizational support (alpha = .86, computed as the mean of the seven dimensions of both domains) and the Instructional support (alpha = .91, computed as the mean of the three dimensions of this domain). The two scales were moderately correlated, $r = 0.67$.

Prior to data collection, the observers participated in a two days training on CLASS, followed by a certification test in which they watched five 20–minute video segments of classrooms and made ratings. All three observers reached the reliability criterion of 80% of the scores within one scale point of the master codes. During data collection, the observers' reliabilities were tested on the CLASS using videotapes of preschool classrooms provided by the authors. The inter–rater reliabilities, based on intraclass correlation coefficients, were on average very high, .90, and were between .67 (Negative Climate) and .98 (Language Modeling).

Child-level control variables. Informed by prior research (e.g., Fuhs & Day,

2011), we included children's vocabulary skills as a potential control variable. Verbal ability has been found to be a significant predictor of self-regulation skills (Fuhs & Day, 2011). To assess vocabulary, we used the Peabody Picture Vocabulary Test–Revised (PPVT–R; Dunn, 1986). In this test, four pictures are presented to the child, and the child is asked to point to the one that matches the word read aloud by the researcher. This measure has been widely used and correlates with measures of language and academic achievement (Blair & Razza, 2007). The translated Portuguese version has been used in various studies (e.g., Bairrão, Leal, Fontes, & Gamelas, 1999), with reasonably reliable and valid scores for preschoolers. Higher scores on this measure indicate higher levels of vocabulary skills. The internal consistency was adequate, $\alpha = .82$.

Data Analyses

Descriptive and correlational analyses were conducted first. Because of the hierarchical nature of the data, where children were nested within classrooms, multilevel modeling was used, using Mplus Version 6 (Muthén & Muthén, 1998–2010). Intraclass Correlation Coefficients (ICC) were computed to determine the proportion of variance at Level 2 (between classrooms). ICC ranged from .18 to .25 for observed self–regulation. This supported the use of multilevel modeling to take into account the nonindependence of observations, and to correct the standard errors that otherwise would be underestimated. We then fitted a series of models. In the models, the quality of teacher–child relationships was entered in at Level 1 (individual level) and the quality of Emotional/Organizational and Instructional Support at the classroom level were entered in at Level 2 predicting gains in self–regulation scores.

Model 1 examined main effects of process quality variables and Model 2 examined the interaction terms of the classroom-level and individual-level social

process variables with the initial levels of self-regulation. Tests of the interaction terms evaluated our hypotheses that process quality, both at the classroom and individual levels, was more positively related to gains over time for children with lower initial levels of self-regulation. Child–level control variables, namely child's age and vocabulary, were only included in the models when statistically significant.

We examined whether the parameter estimates differed for boys and girls using the multiple group comparison approach. A series of nested models in which successive parameters were constrained to be equal across gender were estimated and compared sequentially by testing the decrease in model fit using the Satorra–Bentler scaled Chi-square difference test. The complex procedure of Mplus was applied to address the hierarchical nature of data and correct standard errors for nesting within classrooms.

Missing data for any one variable ranged between 0.5% and 12.8%. Complete data were available for all children for child age, gender, and CLASS. Observed self–regulation and vocabulary at T1 had less than 5% missing data, and observed self–regulation at T2 had 11.8% missing data. In addition, 12.3% of the sample were missing data on teacher–child relationships. Missingness on these variables did not predict any of the other variables. Little's MCAR test, $\chi 2\ (30) = 38.55$, $p = .135$, suggest that data were missing completely at random. To account for missing data, full information maximum likelihood estimation with robust standard errors was used (FIML) to prevent sample size reduction and subsequent loss of statistical power (Enders, 2001). FIML does not impute scores when they are missing but rather uses all available data, including cases with incomplete data. FIML parameter estimates have been shown to be effective and less biased than traditional missing data techniques (Enders, 2001). Regarding effect sizes, we present the standardized coefficients that can be used as effect sizes (Durlak, 2009). In keeping with previous

research, the following values were used to interpret the magnitude of the effects: .10 indicated a small effect, .30 a moderate effect, and .50 a large effect (Durlak, 2009)

Results

Descriptive Statistics

Descriptive statistics and correlations between all study variables are summarized in Table 1. Because the correlations do not take into account the multilevel data structure, results should be interpreted with caution. Overall, scores on the quality assessments were in the mid–range for the CLASS Emotional/Organizational Support but relatively low for the CLASS Instructional Support. Regarding teacher–child relationships, teachers reported low levels of teacher–child conflict and high levels of closeness. For self–regulation, children made significant gains on observed self–regulation, from the beginning of the year to the end of the year, t (184) = –8.86, $p < .01$. Associations between child gender and teacher–child relationships were found, with boys being rated as having more conflictual relationships than girls, as reported by teachers. However, there were no significant differences between boys and girls on observed self–regulation and closeness. The self–regulation scores at T1 were significantly positively correlated with self–regulation scores at T2. Small positive associations between closeness and observed self–regulation were found. No other statistically significant correlations between self-regulation and the classroom social process variables were found.

Multilevel modeling results

Model 1 tested the main effects of dyadic teacher–child relationships and classroom levels of quality on self–regulation through multilevel modeling. Child self–regulation at T1, teacher–child closeness and conflict were included as predictors of within–classroom variance, whereas CLASS emotional/organizational and CLASS instructional support were included to account for between–classroom variance.

Standardized coefficients and their standard errors are presented in Table 2. Results revealed that teacher–child closeness predicted improvements in observed self–regulation skills at T2, $B = .18$, $SE = .07$, $p = .010$. No significant main effects of other dimensions of process quality were found.

Model 2 included the interaction terms to examine the extent to which the effects of the quality of dyadic relationships and classroom interactions on observed self–regulation depended on children's initial levels of self–regulation. A significant interaction effect was found between classroom–level instructional support and observed self–regulation at T1, $B = –.28$, $SE = .13$, $p = .029$. This significant interaction effect is depicted in Figure 1, using the simple slope technique from Aiken and West (1991). In this procedure, the effects of instructional support on self-regulation at T2 were estimated at 1 standard deviation below the mean and 1 standard deviation above the mean on instructional support and self-regulation at T1 variables. Results indicated instructional support was positively related to gains in observed self–regulation at T2 for children with low initial levels of self–regulation at T1. No other moderation effects were found.

To test whether the associations among variables were similar for boys and girls, a set of multiple group analyses was conducted. The results revealed non-significant chi-square differences at each step, ranging from ΔS-B $\chi 2 = 0.27–1.91$, *ns.*, suggesting that the pattern of associations among variables was comparable for girls and boys. Specifically, the magnitudes of the regression coefficients for the main effects were similar for boys and girls. Constraining the interaction effect instructional quality x initial self-regulation to be equal across gender, however, resulted in a significant decrease in model fit, ΔS-B $\chi 2 = 16.94$, $p < .001$, suggesting that the moderating effect of instructional quality on self-regulation differed for boys

and girls. For girls, there was a significant moderating effect of instructional quality, $B = –.26$, $SE = .09$, $p = .005$. In contrast, no moderating effects were evident for boys, $B = .04$, $SE = .08$, $p = .618$.

Discussion

In the current study, we examined classroom environment and perceived teacher–child relationships as predictors of self–regulation in a socially disadvantaged sample of preschool children. A strength of this study was the simultaneous examination of distinct dimensions of process quality to clarify the aspects of process quality that might facilitate self–regulation. Another strength was the use of different methods to capture these aspects. Our study revealed three main findings. First, children's gains in observed self–regulation were associated with emotionally close dyadic teacher–child relationships. Second, the quality of instructional support was associated with gains in observed self–regulation for children showing difficulties in self–regulation at the beginning of the preschool year. Third, this effect was more pronounced for girls than for boys.

Observed self–regulation and close teacher–child relationships

We found a relation between teacher–child closeness reported by teacher and gains in child's observed self–regulation. This finding is in line with theoretical arguments that self–regulation is improved when children are involved in warm relationships with caring teachers (Blair & Diamond, 2008). Accordingly, supportive teachers are likely to model child's behaviors supporting the internalization of appropriate self–regulation skills and to provide opportunities for self–directed behaviors, gradually facilitating the child's increasing capacity to self–regulate (Blair & Diamond, 2008).

These findings complement similar findings on the associations between parental warmth and adaptive self–regulation skills (Bernier et al, 2010; Chang et al.,

2011). For instance, Bernier and colleagues (2010) examined parent–child relationships and found that mothers who were more sensitive and more autonomy supportive had children performing better on self–regulation tasks several months later. Our results suggest that sensitive, warm, and responsive relationships with teachers play an important role in children's developing self–regulation ability as well. In addition, the results from this study converged with a large body of research documenting that higher levels of teacher–child closeness are linked to children's school success (Buyse et al., 2008; Hughes & Kwok, 2006), but may be among the first studies to link emotionally supportive teacher–child relationships to self–regulation gains in preschool children.

Contrary to our expectations as well as to some prior research (Berry, 2012), conflict was not associated with self-regulation. Interestingly, conflict was also not related to closeness, suggesting that a teacher may experiencing high levels of conflict with a particular child, but may nevertheless perceive a warm and close relationship with that child. This finding is in line with prior work conducted in Portugal (Cadima, Doumen, Verschueren, & Leal, 2013) suggesting that teachers do not to feel that higher levels of conflict prevent them from establishing close relationships. Our findings may be somewhat unique to our cultural context, as in most studies conducted in USA conflict and closeness were negatively associated (see Roorda et al., 2011). It is possible that, similarly to Turkish and Greek teachers, Portuguese teachers find it desirable to unconditionally accept all children, irrespective of levels of disagreement in their relationships (Cadima et al., 2013). In line with this view, we can speculate that conflict does not have a negative effect on self-regulation in part because of the positive effect of closeness. It is also possible that, for children with high conflictual relationships with their teachers, other meaningful partners, such as peers and parents, play an important role in the development of self-regulation skills.

Overall, findings from this study point to the importance of examining the effects of both conflict and closeness in the development of self-regulation.

Observed self–regulation and instructional support: moderating effects

In addition to emotionally–close relationships, our results suggested a link between instructional quality and observed self–regulation for children with self–regulatory difficulties at the beginning of the preschool year. Consistent with the notion that child initial self–regulation interacts with the learning environment to affect his or her progress (Liew et al., 2010; Rudasill & Rimm–Kaufman, 2009), findings from the current study suggest that children with low levels of self–regulation skills at the beginning of the preschool year became more proficient in classrooms where the teacher promoted interactions that encouraged communication and reasoning, developed concepts coherently, and gave more feedback relevant to learning. It has been suggested that engaging in thought–provoking activities, in which children are encouraged to communicate and use language to develop reasoning skills, might facilitate more complex thinking that requires planning and working memory (Fuhs et al., 2013). Similarly, teacher and children language exchanges, like parent–child conversations, may offer children verbal tools (e.g., describing one's own actions, planning) that support children's progress from external regulation to self–regulation (Bernier et al., 2010).

Our results showing links between self–regulation and teacher–child instructional quality are also consistent with arguments that intentional interactions that promote language and reasoning are necessary for enhancing learning, particularly for young children with academic difficulties (Hamre & Pianta, 2005). It is notable that children's self–regulation skills were amenable to variations in the quality of everyday interactions. In this study, we did not find an association between the overall emotional and organizational climate and gains in self-regulation. This

finding is inconsistent with prior research on social processes and self-regulation (Fuhs et al., 2013; Rimm-Kaufman et al., 2009) but it is worth noting that these studies did not include social and relational variables at the individual level, which are believed to be important for self-regulation. Moreover, although instructional support is assessed at the classroom level, high-quality instructional support include individualized conversations and feedback loops involving the teacher and each particular child. Therefore, our findings raise the possibility that teacher's individualized attention to the child may be particularly relevant in supporting observed self–regulation skills, either through scaffolding and feedback, or through open talk and extended opportunities for conversation, interactions that underlie both emotionally–close relationships and instructionally supportive interactions.

Observed self–regulation and classroom quality: gender differences

Regarding gender differences, it is important to note that, although boys were reported as having more conflictual relationships with teachers, boys and girls were reported to have similar levels of closeness. In addition, multiple group analyses revealed that closeness was a positive predictor of self-regulation for both girls and boys. Nevertheless, the moderating effect of high levels of instructional support was apparent for girls with low self-regulation skills, but not for boys. In line with Chang et al. (2011), our results may indicate complex, sex differentiated patterns of associations, suggesting that girls and boys may differ in the pathways involved in the development of self-regulation in the classroom. This finding is somewhat consistent with recent research that found that the relation between conflictual relationships and self-regulation extended only for girls (Berry, 2012). In line with the gender role perspective (e.g., Roorda et al., 2011), girls may be more responsive to verbally-mediated interactions in the interpersonal environment because they are more attuned to social relationships. However, considering the inconsistent nature of findings

across studies, the interpretation of the gender differences is speculative and warrants further examination in future work.

Study implications in the Portuguese context

Together these findings suggest that gains in self–regulation skills are supported by sensitive, responsive interactions with teachers. Previous research has indicated associations between classroom quality and children's academic and cognitive competence (Burchinal et al., 2002; Howes et al., 2008, Mashburn et al., 2008). The results of the present study extend this line of work in two important ways. First, we used quality assessments at dyadic and classroom levels, providing a more nuanced understanding of the processes underlying the development of children's self–regulation skills. The weak associations between the levels of process quality confirm the need to consider them both when investigating the effects of process quality. Second, we found associations between process quality and self–regulation skills for socially disadvantaged children, which is particularly important for prevention efforts in the Portuguese context. Portugal currently faces one of the highest percentages of children living in poverty in Europe (21%; Leseman, 2009). Moreover, the economic crisis that started in 2008 in Europe severely affected the Portuguese educational system, leading to several cuts to public funding for social transfers and family benefits (Council of Europe, 2014). Prior research conducted in Portugal additionally suggests that young children under adverse social and economic circumstances are likely to show lower academic skills than their non-risk peers at the end of preschool and that these differences tended to increase throughout first grade (Cadima, McWilliam, & Leal, 2010). Given that self-regulation can be a key component of school success, the identification of social processes that can support the development of self-regulation for this group of children can be useful in more effective prevention and intervention efforts.

In particular, interventions designed to enhance teachers' relationships with individual children can be a relevant strategy to promote children's self-regulation skills. Programs that provide systematic attention to interpersonal experiences, helping teachers to think about and reflect on their behavior have been found to be useful in promoting the quality of relationships (Spilt, Koomen, Thijs, & van der Leij, 2012). Findings from this study suggest that investing resources in relationship-focused programs as early as in preschool might be an effective strategy to facilitate self-regulation skills.

Limitations and future directions

Although results from this study suggest important associations among process quality and self–regulation, there are several limitations that require mention. First, this study is correlational and, as such, causal inferences cannot be drawn. However, these results are extremely important by suggesting that everyday interactions may play a role in children's development of self–regulation. Second, the number of classrooms was relatively small, which may have restricted the range of process quality levels, limiting the power to detect effects. Further research that includes larger numbers of classrooms is needed in order to more fully understand the associations between process quality, particularly instructional quality, and gains in self–regulation. Third, child observations were conducted from October to December. It is possible that children assessed in December were already benefiting from the quality of teacher-child interactions and results should be interpreted in light of this limitation.

This study provides among the first evidence that teacher–child relationships and classroom climate are important in the development of self–regulation. Given that self–regulation appears to play a key role in later several cognitive and socio–emotional outcomes, understanding its contextual contributors is a worthwhile

endeavor in future research.

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Table 1

Descriptives and correlations among variables

	1	2	3	4	5	6	7	8	*M*	*SD*	Possible range
1. Age									59.60	8.53	
2. Sex [a]	-.08								0.50		
3. Observed self-regulation T1	.48**	.13							20.40	14.23	1-40
4. Vocabulary T1	.58**	-.00	.65**						34.04	.98	
5. Emotional/Organizational Support	.05	-.06	.08	.05					4.85	0.81	1-7
6. Instructional Support	.21	-.16	.08	.07	.64**				2.51	0.75	1-7
7. Closeness	.18*	.06	.25*	.31**	.04	-.13			4.26	0.65	1-5
8. Conflict	.18*	-.16*	.01	.04	-.02	.00	-.14		1.55	0.71	1-5
9. Observed self-regulation T2	.48**	.04	.63**	.56**	-.01	.08	.27**	-.04	27.36	12.27	1-40

[a] 0 = boy

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

Table 2
Summary of multilevel models predicting gains in self-regulation from dimensions of process quality

	Observed self-regulation			
	Model 1		Model 2	
	B	*(S.E.)*	*B*	*(S.E.)*
Level-1				
Observed self-regulation T1	.42**	(.07)	.45**	(.07)
Teacher-report conflict	.09	(.09)	.09	(.08)
Teacher-report closeness	.18*	(.07)	.16*	(.07)
Level-2				
Emotional/organizational support	-.16	(.27)	-.16	(.26)
Instructional support	.26	(.26)	.25	(.24)
Instructional x observed self-regulation T1	-	-	-.28*	(.13)
Emotional/organizational x observed self-regulation T1	-	-	-.14	(.12)
Teacher-report conflict x observed self-regulation T1	-	-	-.14	(.09)
Teacher-report closeness x observed self-regulation T1	-	-	-.10	(.08)

Note. Model 1 includes only main effects. Model 2 added the instructional quality interaction with observed self-regulation.

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

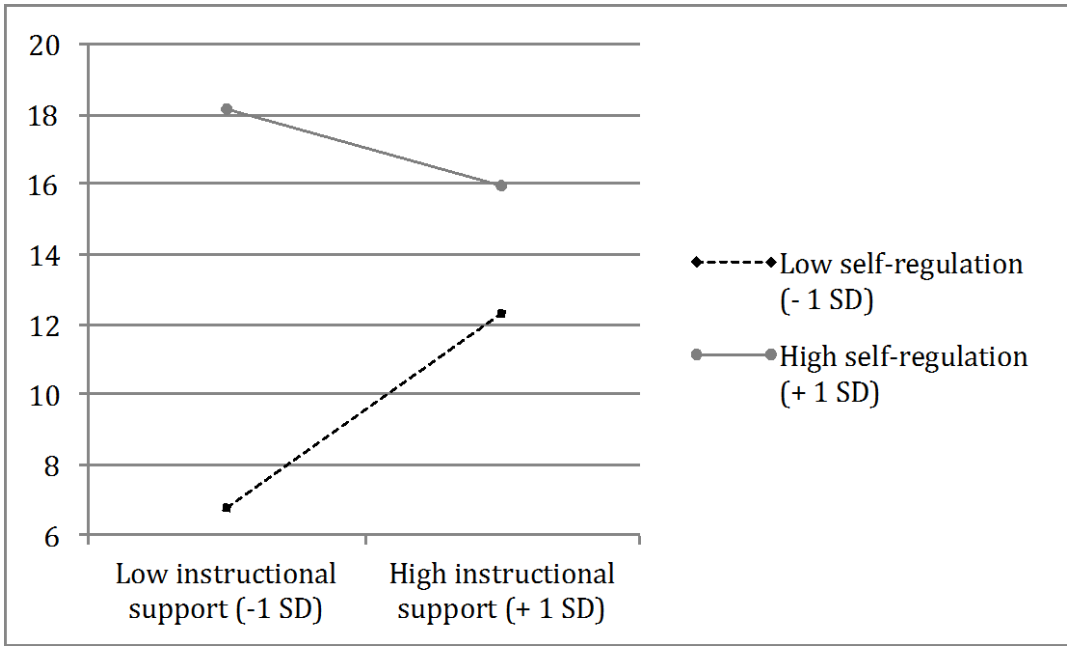

Figure 1. Moderating effects between instructional quality and children's observed self-regulation.