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Evidence for General and Domain-Specific Elements of Teacher–Child Interactions: Associations With Preschool Children's Development

Bridget Hamre
University of Virginia

Bridget Hatfield
Oregon State University

Robert Pianta
University of Virginia

Faiza Jamil
Clemson University

This study evaluates a model for considering domain-general and domain-specific associations between teacher–child interactions and children's development, using a bifactor analytic strategy. Among a sample of 325 early childhood classrooms there was evidence for both general elements of teacher–child interaction (responsive teaching) and domain-specific elements related to positive management and routines and cognitive facilitation. Among a diverse population of 4-year-old children (n = 1,407) responsive teaching was modestly associated with development across social and cognitive domains, whereas positive management and routines was modestly associated with increases in inhibitory control and cognitive facilitation was associated with gains in early language and literacy skills. The conceptual and methodological contributions and challenges of this approach are discussed.

Teachers' interactions with children are resources that foster social, behavioral, and cognitive development in the early years of schooling and beyond (e.g., Curby et al., 2009; Hamre & Pianta, 2005; O'Connor & McCartney, 2007). These conclusions derive consistently from more than a decade of research including both experimental and well-controlled quasiexperimental studies (Howes et al., 2008; Raver et al., 2011). Although this body of work provides credible evidence of the value of teacher–child interactions for young children's development, the accrued evidence also outlines a number of pressing questions for further conceptual and empirical investigation.

One area for further work pertains to the nature of relations between and among domains of teacher–child interaction (e.g., social interactions, instructional interactions) and domains of children's development (e.g., peer relationships, language development). Although the work referenced earlier suggests evidence for teachers' interactions having a causal influence on children's learning and development, challenges in parsing that association for a clearer understanding of effects are posed by frequently noted associations among features of teachers' behaviors. For example, teachers who are highly sensitive are also often more likely to engage in effective language-stimulation practices. In this study we advance and evaluate a model for considering domain-general and domain-specific associations between teacher–child interactions and children's development that relies on a bifactor analytic strategy. The bifactor strategy produces uncorrelated general and domain-specific factors that can be examined as unique predictors of outcomes, even when all factors are in the same model (Chen, Hayes, Carver, Laurenceau, & Zhang, 2012).

This work is situated within a larger debate about the domain specificity of socialization (Downer, Sabol, & Hamre, 2010; Dunn, 2010; Grusec & Davidov, 2010). Grusec and Davidov (2010) argue against a general socialization factor, "but rather each form of relationship between the object and the agent of socialization serves a different function, involves different rules and mechanisms for effecting behavior change, and facilitates different outcomes" (p. 687), a rather strong statement in support of domain specificity. In response, Dunn (2010) notes that a domain-specific approach may offer conceptual clarity but fails to fully acknowledge the real-world overlap among domains, both on the input and outcome sides, pointing out the

Correspondence concerning this article should be addressed to Bridget Hamre, University of Virginia, 350 Old Ivy Way, Suite 100, Charlottesville, VA 22903. Electronic mail may be sent to bkh3d@virginia.edu.

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lack of empirical support for this strong assertion of domain specificity. In this study, we conceptualize teacher–child interactions as having both general and specific features that in turn have general and specific associations with child outcome domains.

Relationships and Interactions—Dyadic Systems

A starting point for conceptualizing domains of teacher–child interactions is to situate the study of adult–child relationships within a developmental systems theory framework (Bronfenbrenner & Morris, 1998). In this framework, teacher–child relationships are *dyadic systems*, with elements that include psychological, behavioral, biological, cultural, and temporal processes. Interactions reflect behavioral exchanges in which information and experience are transmitted between adult and child through channels that operate bidirectionally and transactionally (Sroufe, 2005). These features of dyadic systems operate on a general level to engage the members of the dyad in interactions that foster development. Beyond these general properties of interaction, it is clear that the intent and content of interactions have consequences for children. Within the area of teacher–child interactions this has been most clearly demonstrated in relation to interactions that foster early literacy development. Interactions in which attention is explicitly paid to the phonological properties of written and spoken language are required for most children to gain foundational skills in early literacy (see Phillips, Clancy-Menchetti, & Lonigan, 2008, for review). Unfortunately, conceptualization and measurement of teacher–child interactions have tended to confound the general properties of interaction with features related to intent and focus.

Empirical Support for Domains of Teacher–Child Interaction

Much recent work on teacher–child interactions draws from the teaching through interactions conceptual framework (Hamre & Pianta, 2007) and the observational measure corresponding to this framework, the Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008). Research using the CLASS has provided evidence supporting three hypothesized broad domains of teacher–child interactions—emotional support, classroom organization, and instructional support. Results from a confirmatory factor analytic (CFA) study of observational data from over 4,000 preschool to fifth-grade classrooms (Hamre et al., 2013) suggested that this hypothesized three-factor structure was preferable to one- or two-domain solutions. Numerous studies have linked these domains of teacher–child interactions to students' social, emotional, regulatory, and cognitive development (see Downer et al., 2010, for review).

However, there are important limitations to current work on teacher–student interactions using the CLASS. In general, effect sizes are small (Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Mashburn et al., 2008). The three-factor solution for modeling CLASS data, though the best fitting model in numerous studies, has less than ideal fit indices (Hamre et al., 2013; Pakarinen et al., 2010). In addition, most studies using the CLASS report very high correlations among the three domains, limiting our ability to clearly examine the extent to which individual domains of interactions are associated with specific domains of children's development (Rudasill, Gallagher, & White, 2010).

General and Specific Domains of Teacher–Child Interaction in Early Childhood

These challenges suggest that considering alternative conceptual and methodological approaches to understanding the nature of teacher–child interactions and their impact on children is warranted. This is particularly true given the frequent use of the CLASS in research and practice, including its use in a high-stakes context as a part of the designation and renewal process for Head Start programs across the country. As one starting place for a potential revision, the teaching through interactions framework can be refined using the systems theory-informed argument that there are both generic properties of interactive behavioral exchanges between adults and children and properties that are specific to role, intent, and content. In this reformulation, displayed in Figure 1, we posit a general dyadic systems-level property of teacher–child interactions, responsive teaching, which is hypothesized to foster children's development across all domains (social-emotional, behavioral, and cognitive outcomes). In empirical tests of this hypothesis that rely on the CLASS for observation of teacher–child interactions, this generic factor is assumed to be present in all dimensions measured by the CLASS. We also hypothesize unique elements of teachers' interactions with children reflecting intent and content of interactions that are hypothesized to show differential associations to outcomes in social and cognitive domains (see Table 1). Next we review the literature supporting this reformulation of the teaching through interactions framework.

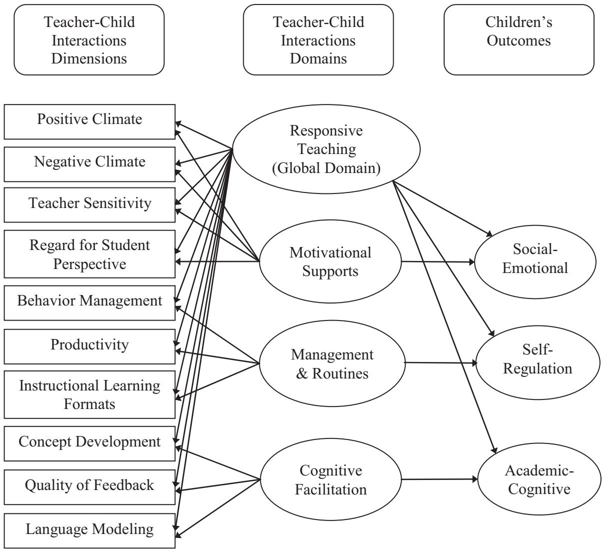

Figure 1. Proposed bifactor model for effects of teacher–child interactions on children's development.

Responsive Teaching: A General Factor of Effective Teaching

At the core of all the dimensions described in the teaching through interactions framework are general features of interaction that reflect a dyadic system-level property that is best captured by the construct of *responsivity*. There is a long history of theory and research describing responsivity as a property of interactions between adults and children, both in the parenting (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008; Landry, Taylor, Guttentag, & Smith, 2008) and early childhood education (Howes & Smith, 1995) literatures. Responsivity is defined as "prompt, contingent, and appropriate reactions to … children" (Bornstein et al., 2008, p. 867). Early work by attachment theorists highlighted the importance of this type of parenting for fostering positive social, emotional, and cognitive development (Ainsworth, Blehar, Waters,

Table 1
Examples of General and Domain-Specific Elements of Teaching Through Interactions (TTI) Dimensions and CLASS Measure

Dimension	Definition	General elements	Domain-specific elements
		Responsive teaching	Motivational supports
Positive climate	Emotional connection, relationships, and positive communications among teacher and children	Makes eye contact; engages in social conversation	Uses positive communications
Negative climate	Level of negativity in the interactions among teacher and children in the classroom	Low reactivity	Displays negative affect or disrespect
Teacher sensitivity	Teacher responsiveness to children's academic, social, emotional, and developmental needs	Anticipates problems; provides assistance	Acknowledges emotions
Regard for student perspectives	Teacher–child interactions and classroom activities that emphasize children's interests and ideas	Notices children's needs for autonomy	Allows choice; encourages child talk and movement
			Proactive management and routines
Behavior management	Teacher use of effective methods to prevent and redirect children's misbehavior	Exhibits low reactivity; monitors students	Sets clear, consistent expectations for behavior
Productivity	Teacher management of time to maximize children's learning opportunities	Uses effective pacing	Provides clear routines; has materials prepared
Instructional learning formats	Teacher facilitation of children's engagement through interesting activities, instruction, and materials.	Is actively involved; expands child engagement	Uses a range of modalities; states learning objectives
			Cognitive facilitation
Concept development	Teacher use of instructional activities that promote children's higher order thinking skills	Recognizes children's level of cognitive functioning	Integrates concepts; makes real-world connections
Quality of feedback	Teacher use of feedback focused on expanding children's learning and understanding	Scaffolds; uses feedback loops	Asks children to explain thinking
Language modeling	Teacher use of language-stimulation and language-facilitation techniques while interacting with children	Uses contingent responding	Asks open-ended questions; uses advanced vocabulary

& Wall, 1978). However, responsivity transcends a single theoretical approach (Landry et al., 2008), with similar descriptions coming from sociocultural (e.g., Rogoff, 1990) and socialization (e.g., Maccoby & Martin, 1983) researchers. There are several more specific features of responsivity that are reflected in each of the dimensions of teacher–child interaction assessed by the CLASS, including active engagement, cue detection, and contingent responding.

Active Engagement

Teachers are active agents and the classroom is intentionally designed to foster development. Children learn more when teachers actively and intentionally use their interactions to engage children in classroom experiences. This emphasis on active and intentional engagement is in contrast to approaches that emphasize a more passive role for the early childhood teacher (Landry, Anthony, Swank, & Monseque-Bailey, 2009). Thus, elements of active engagement may be present in nearly all features of teacher–child exchanges.

Cue Detection

Another common element of interactions is cue detection (Leerkes, 2010). Social information processing theories (Crick & Dodge, 1994) suggest that social behavior is influenced by the extent to which one is able to attend to subtle cues offered by social partners. Effective early childhood teachers notice and respond to children's cues in moment-to-moment bouts of attending and response.

Contingent Responding

For adults to engage effectively with children, they not only must attend to cues but also respond contingently in back-and-forth exchanges that build upon each other to form the functional episodes of attachment and cognitive scaffolding that foster development (Bowlby, 1973). With regard to interactions intended to provide comfort, this means that adults do not simply go give a hug to a child that is upset, but rather they approach the child and gradually respond in ways that lead to the goal of resolving distress. This type of contingent responding is also relevant for children's behavioral regulation and cognitive and language development (see Table 1).

These generic elements of responsive teaching are articulated in the original teaching through interactions framework and here are reformulated as the overriding features of behavioral exchanges in teacher–child dyadic systems. Consistent with more generalized theories of socialization, we hypothesize that these interactions would be foundational to all children's development across domains.

Domain-Specific Elements of Teacher–Child Interactions

Effective teaching of young children requires more than being responsive to children's cues; there is a goal or aim associated with the role and function of being a teacher. We hypothesize at least three features of teachers' interactions with children that reflect the intent of teachers' interactions with children: motivation-inducing supports, management and routines, and cognitive facilitation (see Table 1). To describe these elements of interaction consistent with the bifactor analytic approach, we must consider what they measure *independent* from the general elements of responsive teaching.

Motivation-Inducing Supports

Aside from interacting in a generally responsive manner that engages the child, interactions with teachers must also convey supports that enable the child to approach difficult tasks and persist in those tasks toward mastery. Thus, a major intent of effective teacher–child interactions must be to activate and foster children's motivational processes. The strategies teachers may use to enhance motivation, informed in large part by self-determination theory (Connell & Wellborn, 1991), focus on fostering connection, competence, and autonomy (see Table 1).

Management and Routines

As a leader of intentional, challenging, activity in a complex social setting, a functional intent of teachers is to organize and manage activity, time, and attention. Some classrooms operate like "well-oiled machines" (Pianta et al., 2008), with teachers providing very clear expectations to children about how they should behave and spend their time in the classroom (see Table 1). These strategies support the development of self-regulation and executive functioning skills (Ursache, Blair, & Raver, 2011).

Facilitation of Cognition

Finally, children's exchanges with effective teachers should convey information, expand knowledge, and develop cognitive capacities. As described in Table 1, classrooms in which we see these interactions appear to have elements of "cognitive press" in which teachers intentionally engage with children in ways that foster learning and thinking skills (Peterson & French, 2008). This cognitive stimulation may occur in the context of general interactions as well as in the context of content-specific instruction.

Using Bifactor Models to Understand Broad Constructs With Multiple, Related Domains

The bifactor approach to factor analysis affords an empirical test of the reconceptualized teaching through interactions framework. The bifactor model is an approach to dealing with the common situation in which researchers propose a general construct of interest that is hypothesized to include several highly related domains (Chen, West, & Sousa, 2006). Specifically, the bifactor approach allows for a general factor (i.e., responsive teaching) and domain-specific factors (i.e., motivation-inducing supports, management and routines, and cognitive facilitation) to be simultaneously estimated. Bifactor approaches are increasingly used to help describe developmental and psychological constructs (e.g., Martel, Von Eye, & Nigg, 2010). However, despite their intuitive appeal as a way to understand phenomenon such as teaching, they have not yet been applied to these theories.

The primary rationale for using the bifactor approach for the teaching through interactions framework is the difficulties that arise in analyses with correlated factors such as in the three domains of the CLASS. The standard analytic methods (including analysis of variance [ANOVA], regression, and logistic regression) test the ability of each predictor to explain variability in the outcome above and beyond the other predictors in the model. Highly correlated predictors are therefore less likely to provide significant results, and when significant results are found, the presence of multicollinearity makes them more difficult to interpret and explain. As the analytic methods are based on the independent relations of the predictors with the outcomes, researchers must conceptualize the factors in a measure that are unrelated to the other factors. The bifactor approach allows for greater precision by creating separate scores for general and domain-specific elements, all of which are uncorrelated and thus able to be entered simultaneously into prediction models without issues of multicollinearity.

Current Study

This study addresses three core aims. First, we test the extent to which the bifactor model fits a sample of live observations from 325 preschool classrooms and compare this fit to a traditional three-domain factor model and to two- and one-domain factor models. If the bifactor approach to modeling teacher–child interactions provides a good fit to the data, we then examine the extent to which the general factor of responsive teaching as well as the domain-specific factors predict children's executive functioning, social, and early academic development from fall to spring of the preschool year. We expect responsive teaching to predict growth across all domains, and we expect several domain-specific associations. We hypothesize that children will develop more positive and less conflictual relationships with teachers in classroom with higher motivational support. We expect management and routines to uniquely predict growth in executive functioning and cognitive facilitation to predict growth in early academic outcomes, particularly pertaining to language and literacy. The final aim is to compare this predictive model, utilizing the bifactor approach, to a predictive model using the more traditional three-domain approach.

Method

Participants

Participants in this study included 325 preschool teachers and 1,407 children who were enrolled in their classrooms. The teachers were drawn from an 18-month study of two forms of professional development: (a) a semester-long course focused on effective teacher–child interactions (Phase I) and (b) a year-long consultancy in which coaches provided feedback to improve teachers' interactions with children (Phase II); results from the intervention are described elsewhere (Downer et al., 2012; Hamre et al., 2012).

Sampling

Recruitment for the main intervention study focused on large community-based preschool and Head Start programs in 10 sites across the country. Enrollment took place in two staggered cohorts.

Cohort 1 recruited classrooms from five sites in January 2008, and Cohort 2 recruited classrooms from five additional sites in January 2009. Teachers and program administrators were invited to attend a recruitment meeting at their respective site. Teacher eligibility was determined at this meeting and included: (a) teachers were the lead teacher in a classroom in which the majority of children were eligible for kindergarten the following school year, (b) teachers conducted instruction in English for the majority of the school day, and (c) teachers had access to high speed Internet.

In Phase II, the coaching phase, 401 teachers participated, and teachers were asked to distribute project packets to parents of all children in their classroom. These packets included information regarding the project and consent documents for parents to sign if they wished for their child to be included in the study sample. Of the 401 classrooms, 325 classrooms had at least one child who consented to participate. In the remaining classrooms teachers either dropped out of the study prior to this phase of data collection or no children in their classroom were consented for the study. To determine if the final sample of 325 classrooms with consented children differed in meaningful ways from the larger sample we conducted *t* tests on a variety of classroom and teacher demographics (i.e., teacher education, teacher years of experience, and classroom poverty level). Overall the sample for this study was very similar to the larger sample. Only teacher education differed in the two groups as the final sample had .46 more years of education than teachers in classrooms that did not have any children consent, $t(378) = 2.98$, $p < .01$. Thus, we controlled for teacher education in the multilevel models estimated via maximum likelihood to reduce bias in our estimates.

Teachers

The teachers in this sample were diverse in terms of personal and professional demographics, and the classrooms in which they taught. The sampled teachers were 96% female, with a mean age of 42.4 years ($SD = 10.79$). They were ethnically diverse, with 46.6% African American teachers, 33% White teachers, 13.1% Hispanic teachers, 3.5% Asian teachers, and 3.8% teachers belonging to other ethnic groups making up the sample. The teachers had an average of 14.5 years of teaching experience ($SD = 9.37$), with a range of 0–47 years. Mean years of education for the sample was 15.9 ($SD = 1.62$), with 45% of sampled teachers holding a bachelor's degree and 20% holding an advanced degree.

Classroom composition was, on average, 48% female, with 15% of students in a given class being classified as limited English proficient, and 7% having individualized education plans (IEP) or individualized family service plans (ISFP). Of the classrooms in which sampled teachers taught, 51% had a Head Start designation and 34% were in a public school setting.

Children

The child participants in the study sample had an average age of 4.17 years ($SD = .47$) on September 1. The sampled children were 51% girls and 49% boys. Most of the children were African American (47%) or Hispanic (34%), with smaller numbers of White (11.4%), Asian (2.4%), and other ethnicities (5.2%). Maternal education of the children in the sample was low, with 20.5% of mothers not having finished high school, 19.2% having a high school diploma or its equivalent, and 40.4% having completed some college. College degree attainment was low, with only 7.8% of mothers having associate degrees, 8.8% having bachelor's degrees, and 3.3% having continued their education beyond a bachelor's degree.

Procedures

Data for this study were collected at different time points during the study year. Teacher survey data were collected before the start of the intervention, in the fall of the study year. Direct assessments were administered to the children in the sample during the fall and the spring of the study year by trained data collectors. Live classroom observations using the CLASS (Pianta et al., 2008) were conducted from January to mid-March. Data collectors visited one classroom per day with observations taking place from the beginning of the day until lunch or naptime. Observations typically lasted from 2.5 to 4 hr, depending on the length of the school day, with data collectors attempting to conduct at least four 15-min CLASS cycles during a single observation visit. CLASS observations were completed in 314 of the 325 classrooms.

Data collectors participated in ongoing and intensive training and reliability procedures in child direct assessments and classroom observation, including a 2-day training on direct assessments and a 2-day training on CLASS. They had to pass certification tests on all instruments prior to data collection. Additional training and calibration was provided throughout the data collection windows.

Measures

Teacher–Child Interactions

The quality of teacher–child interactions was measured using the CLASS (Pianta et al., 2008), a validated classroom observation tool that assesses teacher–child interactions across 10 distinct dimensions (Mashburn et al., 2008). Table 1 provides descriptions of each CLASS dimension. Previous research demonstrates that these dimensions are organized into three broad domains (Hamre et al., 2013). Positive climate, negative climate (in which a low score is desirable), teacher sensitivity, and regard for student perspectives all fall into the broad domain of emotional support. Behavior management, productivity, and instructional learning formats are all components of the classroom organization domain. Concept development, quality of feedback, and language modeling comprise the instructional support domain. Each dimension of the CLASS is scored on a 7-point scale, with 1–2 representing low scores, 3–5 representing moderate scores, and 6–7 representing high scores. Twenty percent of live CLASS observation visits were double coded; ICCs calculated at the visit level were .78 to .88. Additional descriptives for CLASS are in Table 2.

Children's Early Academic Skills

The Peabody Picture Vocabulary Test–3rd edition (PPTV–III) is a measure of children's receptive vocabulary skills (Dunn & Dunn, 1997). In this study raw scores were used to understand individual improvement on an outcome from fall to spring. The psychometric properties of the PPVT–III are well established, with evidence for acceptable reliability and validity (Dunn & Dunn, 1997).

Table 2
CLASS and Child Outcome Descriptives

	n	% missing	*M*	*SD*	Min	Max	ICCs
CLASS dimensions[a]							
Positive climate	314	3	5.22	.99	2.25	7.00	.80
Negative climate[b]	314	3	1.34	.64	1.00	6.33	.67
Teacher sensitivity	314	3	4.43	1.25	1.33	7.00	.85
Regard for student perspective	314	3	4.11	1.27	1.00	7.00	.87
Behavior management	314	3	5.60	.97	2.00	7.00	.80
Productivity	314	3	5.75	.79	2.00	7.00	.64
Instructional learning formats	314	3	3.80	1.22	1.00	6.50	.80
Concept development	314	3	1.76	.76	1.00	4.67	.70
Quality of feedback	314	3	2.52	1.00	1.00	5.67	.82
Language modeling	314	3	2.80	1.02	1.00	5.67	.79
CLASS domains[a]							
Emotional support	314	3	5.11	.87	2.42	6.92	.87
Classroom organization	314	3	5.05	.76	1.78	6.78	.76
Instructional support	314	3	2.36	.86	1.00	5.00	.84

Child outcomes (spring)	*n*	% missing	*M*	*SD*	Min	Max
Peabody Picture Vocabulary Test	1197	15	50.59	19.51	6.00	104.00
Woodcock–Johnson, Picture Vocabulary	1030	27	13.61	3.66	2.00	27.00
Print knowledge	1197	15	21.42	11.32	.00	36.00
Phonological awareness	1168	17	14.88	5.57	.00	27.00
Backward digit span	1192	15	1.35	.69	1.00	5.00
Pencil tap	1195	15	.64	.33	.00	1.00
Conflict	882	37	1.80	.92	1.00	5.00
Closeness	882	37	4.49	.58	1.00	5.00

Note. CLASS = Classroom Assessment Scoring System.
[a]Calculated using four cycles. [b]Negative climate is reversed score.

The Woodcock–Johnson–III Psychoeducational Battery (WJ–III; Woodcock, McGrew, & Mather, 2001) is a widely used assessment battery that can be used with individuals from age 2 through adulthood to measure general cognitive abilities and achievement. This study used the raw scores from the Picture Vocabulary subtest to measure expressive vocabulary.

The Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007) is an assessment battery designed to assess preschool children's (3–5 years of age) emergent literacy skills. Of the three subtests of this measure, this study used the raw scores from two: the phonological awareness subtest assessed word elision and blending ability, and the print knowledge assessed children's knowledge of the alphabet, written language conventions, and writing form. In the extant literature, TOPEL subtests have been shown to demonstrate adequate internal consistency (Cronbach's αs = .78 to .89) and concurrent validity from .41 to .43 (Lonigan, Keller, & Phillips, 2004).

Child Self-Regulation

Two components of children's self-regulation were assessed for this study: inhibitory control and working memory. Inhibitory control was assessed using the pencil tap test (Smith-Donald, Raver, Hayes, & Richardson, 2007). This test asks children to tap a pencil once when the assessor taps twice, and vice versa. The percentage of correct responses is measured to obtain a final score for this assessment. This measure has been shown to have good concurrent and construct validity (Smith-Donald et al., 2007), and internal consistency for the current sample was high (Cronbach's α = .93). Working memory was assessed using the backward digit span task (Carlson, 2005), in which the assessor speaks a list of digits, and the child is asked to repeat them in reverse order. In each trial the number of digits is increased by one. Higher scores on this measure indicate higher working memory capacity.

Teacher–Child Relationships

The Student–Teacher Relationship Scale (STRS; Pianta, 2001) was used to examine teachers' relationships with the individual children in their classrooms. This 15-item, teacher-reported measure is completed by the teacher on each child in their classroom. It is scored on a 5-point scale and yields scores on two factors: closeness and conflict. The STRS has excellent psychometric properties across multiple studies and samples, and predicts children's classroom behavior and academic outcomes (e.g., Pianta, Steinberg, & Rollins, 1995). Within this sample both closeness and conflict scales demonstrated high internal consistency, with alphas at .88 and .82 respectively.

Teacher, Child, and Family Characteristics

Teachers completed a survey at the start of the study reporting information on their education, teaching assignment, and professional development experiences. Parents of each child in the study sample completed a family questionnaire that provided basic demographic information about participating children and their families, including child gender, race/ethnicity, family income, and levels of maternal education.

Analytic Plan

In the bifactor approach to factor analysis there is a general factor that is hypothesized to account for the commonality of the items measured to represent a construct. The CLASS measures teacher–child interactions, a multifaceted construct. Thus, the first aim of the study was to explore the fit of a bifactor model of the CLASS, compared to a CFA approach. Reise, Moore, and Haviland (2010) suggest that in this case, a bifactor approach may afford more insight to the construct in lieu of a CFA. We proposed a domain-general factor of responsive teaching that is composed of all 10 CLASS dimensions that measure teacher–child interactions. Furthermore, we hypothesized *unique* domain-specific factors (i.e., motivational supports, management of behavior and routines, and cognitive facilitation) that are expected to exist in addition to the general factor. That is, the domain-specific and domain-general factors are *uncorrelated*, providing a possible solution to the multifaceted, complex operationalization of teacher–child interactions using the CLASS measure. To test the use of the bifactor approach with the CLASS, we first compared results for the bifactor model to the original three-factor structure that has been previously validated (Hamre et al., 2013), as well as one- and two-factor models.

The second aim of the study was to examine the extent to which the general and domain-specific factors obtained through the bifactor model were associated with gains in children's social, self-regulatory, and early academic skills in preschool. Children's social, self-regulatory, and early academic skills in the spring of prekindergarten were regressed on factor scores derived from the bifactor model analyses and child (i.e., child age, gender, maternal education, time between assessments, fall scores) and classroom (i.e., teacher education, teacher years of experience, classroom setting, literacy curriculum, proportion of poverty, intervention assignment) covariates. Latent variables were created for literacy and language given that the print knowledge and phonological awareness as well as expressive and receptive language were highly correlated. The TOPEL print knowledge and phonological awareness raw scores significantly loaded on the literacy latent factor ($\beta = .59$ and $\beta = .80$, respectively), and the PPVT and WJ raw scores significantly loaded on the language factor ($\beta = .88$ and $\beta = .85$, respectively). Models were executed separately for each area of development. To address the third aim of the study we then compared these results to those obtained using the more traditional three-factor approach.

Given the nested nature of the data, multilevel analyses were employed with children nested within classrooms. Analyses were estimated using full-information maximum likelihood (FIML) in Mplus 6.0 (Muthén & Muthén, 1998–2010) to account for missing data at the classroom and child levels. FIML uses all available information in the data to create parameter estimates and standard errors for the missing values (Buhi, Goodson & Neilands, 2008). Table 2 provides descriptive data on CLASS and child outcome variables.

Results

Refinement of the Bifactor Model of the CLASS

The first aim of study was to examine extent to which the hypothesized bifactor model—including a general factor (responsive teaching) and three domain-specific factors (motivational support, management and routines, and cognitive facilitation) fit the data. As described in detail elsewhere, the hypothesized model did not fit the data so several steps were taken on both conceptual and empirical grounds to refine the bifactor model.

Consistent with recommendations for fitting bifactor models (Reise et al., 2010), the initial bifactor model was estimated with all four factors constrained to be uncorrelated, one of the loadings in each factors set to 1, and the error terms for each domain constrained to be uncorrelated. This model failed to converge. We then used both conceptual and empirical approaches to modifying the bifactor model. Theory and previous research (Downer et al., 2010) suggested that the cognitive facilitation factor was the most unique of the hypothesized domain-specific factors. It seemed plausible that the other two domain-specific factors, motivational support and management of behavior and routines, were too highly correlated to allow for convergence of the hypothesized model in which the covariance between them was set to zero.

To explore this possibility, an exploratory bifactor model was executed allowing the three domain-specific factors (motivational support, management and routines, and cognitive facilitation) to covary, but continuing to constrain the covariance between the three domain-specific factors and the general responsive teaching factor to zero. As expected, the motivational support and management and routines factors were highly correlated ($r = .76$), suggesting that the domain-specific factors were not unique. However, cognitive facilitation was only mildly correlated with motivations support ($r = .24$) and management and routines ($r = .14$), suggesting that cognitive facilitation is a unique domain-specific factor. This suggested that the hypothesis regarding three domain-specific factors was not supported and in subsequent analyses the motivational support and management and routines factors were combined.

A second bifactor model was then examined including the general responsive teaching factor and two domain-specific factors (motivational support/management and routines, and cognitive facilitation). In this model, all three factors were constrained to be uncorrelated, one of the loadings in each factor was set to 1, and the error terms for domains were constrained to be uncorrelated. This revised model showed adequate model fit based on a collection of fit statistics including the comparative fit index (CFI = .96), root mean square error of approximation (RMSEA = .11), and standardized root mean square residual (SRMR = .04). For the motivational support/management and routines factor, three of the corresponding dimensions (teacher sensitivity, regard for student perspectives, and instructional learning formats) did not demonstrate significant loadings and loaded below an absolute value of .15. As per the suggestions of Reise et al. (2010), these dimensions were removed from this domain-specific factor and were constrained to load solely on the general responsive teaching factor. Based on the remaining dimensions (behavior management, negative climate reversed, productivity, and positive climate), the factor was renamed *positive management* and *routines* to reflect the mixture of the hypothesized management and routines with the elements of a classroom climate marked by low negativity and high positivity. The final bifactor model (Table 3) reflects one general domain-specific factor of teacher–child interactions, responsive teaching, and two additional domain-specific factors, positive management and routines and cognitive facilitation. Loadings, fit statistics, and descriptive information are provided in Tables 3 and 4.

Comparison of Bifactor to Alternative Models

For comparison purposes, one-factor, and two-factor, and three-factor confirmatory factor analyses (CFA) were estimated in an effort to replicate the previously reported three-factor model in Hamre et al. (2013), with the domains of emotional support and classroom organization combined in the two-factor solution. Results from all analyses are presented in Table 3, including factor loadings and fit indices. None of the alternative CFA models fits the data as well as the bifactor model; the bifactor model showed, on average, good fit. The SRMR and CFI both demonstrated good fit, and the RMSEA value was above the acceptable threshold for good fit (Hu & Bentler, 1999), though it was lower in the bifactor model than in other models.

Further insight on the structure of these domains and dimensions can be gleaned from an examination of correlations among the factor scores derived from the different solutions. Table 4 replicates the high correlations between the factors in the three-factor CFA (Hamre et al., 2013). The factors derived from the two-factor solution are also highly correlated with one another ($r = .73$). As noted earlier, using these scores in predictive models would lead to serious issues with multicollinearity. In contrast, as specified by the model through which they were derived, the factors from the bifactor approach are uncorrelated.

Hayduk, Cummings, Boadu, Pazderka-Robinson, and Boulianne (2007) argue that while model fit is important, the theoretical value in the model is of equal importance. The bifactor model suggests that the hypothesized model mostly fits the data well, and suggests an overall, responsive teaching factor and two domain-specific factors, positive management and routines and cognitive facilitation, and is an improvement over the three-factor model. This suggests that it is a viable model for future work to consider. The three uncorrelated factors afforded in the bifactor model allow ease in precision to understanding the specific contribution of individual components of classroom quality to child academic and social skills in preschool.

Associations Between Teacher–Child Interactions and Children's Development

The second aim of the study was to examine the extent to which teachers' interactions with children, modeled using the bifactor approach, demonstrated both domain-general and domain-specific associations with children's development across the preschool year. Table 5 presents results from this model. As hypothesized the responsive teaching factor was associated with growth across multiple developmental domains. Children in classrooms in which the teacher engaged in responsive teaching demonstrated more growth in early language and literacy skills, increased working memory, and had decreased levels of teacher–child conflict. Responsive teaching was not related to gains in inhibitory control or teacher–child closeness.

There was also evidence to support the hypothesis that domain-specific factors would relate differentially across outcomes. Cognitive facilitation predicted gains only in early literacy and language skills, and was unrelated to other child outcomes. Similarly, as hypothesized, children in classrooms with more positive management and routines demonstrated gains in inhibitory control. The only child outcome that was not predicted by either the general or domain-specific factors was teacher–child closeness.

These analyses were repeated using the more traditional three domains of CLASS, emotional support, classroom organization, and instructional support, entered simultaneously (Table 6). When comparing these results to those presented earlier, there are a few commonalities. The instructional support domain of CLASS predicted gains in preschool children's language and literacy. Furthermore, children in classrooms observed to have higher classroom organization, demonstrated gains in inhibitory control. Both of these findings are mirrored in the bifactor model. There are also unique results from the three-factor predictive model. One was expected. Children who had teachers who were able to effectively manage time, behavior, and lessons, as demonstrated by higher classroom organization, displayed gains in literacy and working memory. However, two findings do

Table 3
Standardized and Unstandardized Factor Loadings and Model Fit for the Bifactor Model and the CFA Models (Three Factors, Two Factors, and One Factor) for Teacher–Child Interactions (n = 314 classrooms)

	Bifactor model		Three-factor CFA				Two-factor CFA		One-factor CFA
Domains	Responsive teaching β (B)	Proactive management and routines β (B)	Cognitive facilitation β (B)	Emotional support β (B)	Classroom organization β (B)	Instructional support β (B)	Emotional support and classroom organization β (B)	Instructional support β (B)	β (B)
CLASS dimensions									
Positive climate	.77 (1.00)	.31 (1.00)		.78 (1.00)			.77 (1.00)		.79 (1.00)
Negative climate[r]	.34 (.32)	.56 (1.77)		.37 (.32)			.38 (.32)		.40 (.33)
Teacher sensitivity	.93 (1.54)	.00 (−.03)[a]		.95 (1.57)			.94 (1.56)		.92 (1.49)
Regard for student perspectives	.89 (1.47)	−.12 (−.51)[a]		.87 (1.46)			.87 (1.46)		.83 (1.36)
Behavior management	.58 (.73)	.73 (2.30)			.55 (1.00)		.80 (1.28)		.80 (1.25)
Productivity	.38 (.39)	.44 (1.14)			.33 (.51)		.59 (.71)		.60 (.71)
Instructional learning formats	.80 (1.29)	−.14 (−.56)[a]			.77 (1.85)		.37 (.39)		.39 (.39)
Concept development	.53 (.53)		.59 (1.00)			.80 (1.00)		.79 (1.00)	.55 (54)
Quality of feedback	.62 (.82)		.73 (1.61)			.93 (1.54)		.93 (1.55)	.67 (.86)
Language modeling	.68 (.92)		.58 (1.31)			.91 (1.53)		.91 (1.53)	.74 (.96)
Variances[a]	.58	.09	.20	.57	.26	.37	1.39	.37	.60
Model fit									
CFI	.96			.93			.92		.94
RMSEA	.11			.13			.14		.13
SRMR	.04			.08			.07		.07

Note. CFA = confirmatory factor analysis; CLASS = Classroom Assessment Scoring System; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.
[a]Coefficient not significant.

Table 4
Descriptives and Correlations of Unstandardized, Centered Factor Scores for Bifactor and CFA Models (n = 314)

	M	*SD*	1	2	3	4	5	6	7	8
Bifactor model										
1. Responsive teaching	.00	.74	—							
2. Proactive management & routines	.00	.28	.00	—						
3. Cognitive facilitation	.00	.42	.00	.00	—					
Three-factor CFA										
4. Emotional support	.00	.73	.99**	.02	.02	—				
5. Classroom organization	.00	.52	.98**	.00	.18**	.98**	—			
6. Instructional support	.00	.59	.74**	.01	.71**	.71**	.80**	—		
Two-factor CFA										
7. Classroom organization and emotional support	.00	.73	.99**	.02	.05	.99**	.98**	.73**	—	
8. Instructional support	.00	.59	.74**	.01	.71**	.71**	.80**	1.00**	.73**	—
One-Factor CFA										
9. Teacher–child interactions	.00	.75	.99**	.06	.13**	.99**	.98**	.78**	.99**	.78**

Note. CFA = confirmatory factor analysis.
***p* < .01.

Table 5
Bifactor Model Predicting Spring Child Outcomes (n = *1,407 Children, 325 Classrooms*)

	Language[a]		Literacy[b]		Backward digit span		Pencil tap		Conflict		Closeness	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Fall score on outcome measure[c]	.45***	.03	.44***	.02	.41***	.03	.37***	.03	.65***	.03	.58**	.04
Days between assessments/reports	.05*	.02	.06*	.03	.03	.03	.07*	.03	.02	.03	.04	.04
Child age	.10***	.02	.18***	.03	.13***	.02	.25***	.03	.00	.03	.03	.04
Mother years of education	.05*	.02	.03	.02	.08**	.02	.09**	.03	.00	.03	.03	.03
Male	−.01	.02	−.07**	.02	−.01	.02	−.04	.03	.05	.03	−.11**	.03
African American[d]	−.07*	.03	.04	.03	−.03	.05	−.03	.04	−.12*	.05	.06	.05
Hispanic	.08**	.03	.00	.04	−.09	.05	−.02	.04	−.12*	.05	.00	.05
Other ethnicity	−.03	.02	.01	.04	.05	.04	.02	.05	−.03	.03	.00	.03
Teacher years of education	.02	.02	.03	.03	.04	.03	−.08*	.03	.03	.04	−.05	.04
Teacher years of experience	.00	.02	.03	.02	−.03	.03	−.03	.03	−.01	.03	.05	.03
Classroom average income to needs	.05*	.02	.07*	.03	.02	.03	.02	.03	−.04	.04	.08*	.03
Head Start[e]	.04	.02	−.04	.03	−.02	.03	−.01	.03	−.02	.04	.00	.04
Public school[e]	.01	.02	.04	.03	−.01	.04	.02	.03	.02	.04	−.03	.04
Language/literacy curriculum[f]	.07**	.02	.16***	.03	.01	.04	.01	.03	−.06	.04	.03	.04
Responsive teaching	.06**	.02	.07**	.02	.06**	.03	−.01	.03	−.08*	.03	.03	.03
Positive management and routines	.01	.02	.03	.02	.02	.03	.07**	.03	−.02	.03	−.04	.03
Cognitive facilitation	.05**	.02	.06**	.02	.04	.03	.01	.03	−.01	.03	.03	.03
R^2	.91***		.94***		.29***		.31***	.46***		.41***		

Note. All models were run in multilevel models and controlled for intervention group.
[a]Language = latent factor of Peabody Picture Vocabulary Test and Woodcock–Johnson Picture Vocabulary. [b]Literacy = phonological awareness and print knowledge. [c]Averaged score for latent variables (language and literacy). [d]Reference group for ethnicity is Caucasian. [e]Reference group: public agency, nonprofit, or for profit. [f]Reference group is general curriculum.
**p* < .05. ***p* < .01. ****p* < .001.

not fit with any hypotheses or prior work—instructional support was associated with higher teacher–child closeness in the spring, and emotional support was associated with *decrease*s in child inhibitory control.

Discussion

Results from this study provide new insight into the ways in which teachers' interactions with young children in preschool classrooms support growth

Table 6

Three-Factor Model Predicting Spring Child Outcomes (n = 1,407 Children, 325 Classrooms)

	Language[a]		Literacy[b]		BDS		Pencil tap		Conflict		Closeness	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Fall score on outcome measure[c]	.45***	.03	.44***	.03	.41***	.03	.38***	.03	.65***	.03	.58**	.04
Days between assessments/reports	.05*	.02	.06*	.03	.03	.03	.07*	.03	.02	.03	.04	.04
Child age	.10***	.02	.18***	.03	.13***	.02	.24***	.03	.00	.03	.03	.04
Mother years of education	.05**	.02	.04	.02	.08**	.02	.10**	.03	.00	.03	.03	.03
Male	−.01	.02	−.07**	.02	−.01	.02	−.04	.03	.06*	.03	−.11**	.02
African American[d]	−.07*	.03	.04	.03	−.03	.05	−.03	.04	−.11*	.05	.06	.05
Hispanic	.08**	.03	.00	.04	−.09	.05	−.02	.04	−.12*	.05	.00	.05
Other ethnicity	−.03	.02	.01	.04	.05	.04	.02	.05	−.03	.03	.00	.03
Teacher years of education	.02	.02	.02	.03	.03	.03	−.11**	.03	.04	.04	−.05	.04
Teacher years of experience	.00	.02	.04	.02	−.03	.03	−.02	.03	−.01	.03	.05	.03
Classroom average income to needs	.05*	.02	.07*	.03	.02	.04	.02	.03	−.04	.04	.08*	.03
Head Start[e]	.04	.02	−.04	.03	−.03	.03	−.01	.03	−.02	.04	.00	.04
Public school[e]	.01	.02	.04	.03	−.01	.03	.02	.03	.01	.04	−.03	.04
Language/literacy curriculum[f]	.07**	.02	.15***	.03	.01	.03	.01	.03	−.06	.04	.02	.04
Emotional support	−.03	.03	−.05	.04	−.05	.04	−.12*	.05	−.02	.06	.00	.06
Classroom organization	.03	.03	.09	.04	.09*	.04	.14**	.05	−.06	.05	−.03	.05
Instructional support	.08***	.02	.09**	.03	.05	.03	.00	.04	−.02	.04	.07*	.04
R^2	.91***		.94***		.29***		.31***		.46***		.41***	

Note. All models were run in multilevel models and controlled for intervention group. BDS = backward digit span.
[a]Language = latent factor of Peabody Picture Vocabulary Test and Woodcock–Johnson Picture Vocabulary. [b]Literacy = phonological awareness and print knowledge. [c]Averaged score for latent variables (language and literacy). [d]Reference group for ethnicity is Caucasian. [e]Reference group: public agency, nonprofit, or for profit. [f]Reference group is general curriculum.
*$p < .05$. **$p < .01$. ***$p < .001$.

across developmental domains, adds to debates regarding domain-specific versus domain-general theories of socialization, and provides evidence of the methodological utility of the bifactor approach as one way to model teacher–child interaction data. These results are particularly important given the intensive focus on teacher–child interactions as a part of early childhood policy reforms and the increasing number of studies using the CLASS to document impacts on children's development.

The findings suggest that arguments regarding general or domain-specific approaches to socialization (Dunn, 2010; Grusec & Davidov, 2010) may be oversimplified, with results suggesting some truth to both sides of the argument. Children in classrooms with teachers offering more responsive interactions, a *general* element of teachers' interactions, demonstrated greater gains in cognitive, self-regulatory, and relational functioning. However, there was support for domain specificity as well, with teachers' positive management and cognitive stimulation providing unique prediction of children's development.

On the methodological side, the bifactor approach to modeling CLASS data fit the data significantly better than the typical three-factor model and alternative one- and two-factor models. The fact that the bifactor model produced three *uncorrelated* factors demonstrated utility in predicting children's outcomes by helping mitigate issues related to high multicollinearity among domains of teacher–child interactions measured by the CLASS. Although these findings are tempered by the small magnitude of associations between CLASS and child outcomes, as well as some discrepancies between predictive models using the bifactor versus three-factor approaches that require further exploration, they offer preliminary evidence of the value of using bifactor approaches to model teacher–child interaction data.

General and Domain-Specific Elements of Effective Teacher–Child Interactions

The first aim of this study was to examine the extent to which a revised conceptualization of the teaching through interactions framework, one that allows for both general and domain-specific elements of teacher–child interactions, adequately described variability in these interactions in a diverse set of early childhood classrooms. Results confirm the value of this reconceptualization, with the bifactor approach demonstrating superior fit to the data compared to alternative models. However, results also varied from hypotheses in important ways, suggesting that the conceptual model and/or the measure may benefit from further refinement.

As expected, all CLASS dimensions loaded significantly onto the general factor, referred to as responsive teaching. Responsive teachers are aware of and responsive to children's emotional, behavioral, and cognitive cues and make active efforts to respond in supportive ways. Most of the dimensions that loaded most highly on the responsive teaching factor (teacher sensitivity, regard for student perspectives, instructional learning formats, and positive climate) attend to teachers' active engagement, cue detection, and contingent responding. The high loading for regard for student perspectives was somewhat surprising, as this dimension of teaching practice was hypothesized to include a unique element focused on teachers' support of children's autonomy. It may be, however, at least in early childhood classrooms, that teachers who are generally responsive also tend to have this more child-centered instructional approach.

With regard to the domain-specific elements of teacher–child interactions, the cognitive facilitation factor fit as expected, with moderate to high loadings from each of the instructional support dimensions. Thus, a unique property of teacher–child interactions in early childhood settings reflects elements of "cognitive press" in which teachers intentionally engage children in content, in ways that foster learning and thinking skills (Peterson & French, 2008). It is also likely, although in need of future study, that the cognitive facilitation factor is picking up important variance related to teachers' transmission of content, such as literacy, math, and science instruction (Cabell, DeCoster, LoCasale-Crouch, Hamre, & Pianta, 2013).

The second factor, derived empirically using the bifactor approach, combined some elements of the hypothesized motivational support and management and routines factors. Examination of factor loadings from the final model suggest that after accounting for more general responsiveness, early childhood teachers differ in their abilities to provide management and routines that are proactive but also positive in nature and lacking in negativity, thus the suggested name for this domain-specific factor, positive management and routines.

The lack of empirical support for the unique motivational support factor does not mean that these unique emotional and motivational elements of classrooms do not exist. For example, Domitrovich et al. (2008) discuss several elements of emotional support, such as the presence of emotion coaching and social problem-solving dialogues in which teachers actively seek out opportunities to discuss emotional content with children. Future research might examine whether inclusion of measures assessing these elements of interactions provided unique predict children's development. Alternately, the CLASS could be modified to better capture these elements.

Associations Between Teacher–Child Interactions and Children's Development

This study provides initial support for the validity of the revised teaching through interactions framework in terms of prediction to children's development, while also raising interesting questions with implications for both theory and measurement. As hypothesized, the general responsive teaching factor predicted children's development across domains. Children in classrooms with more responsive teachers made greater gains in early literacy and language, developed better working memory skills, and decreased in levels of teacher-report conflict. However, there is also evidence of domain specificity, with positive management and routines demonstrating associations with gains in children's inhibitory control and cognitive facilitation associated with gains in early language and literacy. Consistent with prior work, all associations between CLASS and outcomes were relatively small in magnitude.

The simplest way to compare the relative value of the bifactor versus the three-factor CFA approach to understanding the domain-specific associations between teacher–child interactions on children's development is to compare our substantive interpretation of these statistical models for any of the outcomes. Starting with language development we see that the three-factor approach suggests that only instructional support is a significant predictor. But the bifactor model suggests a role for both general elements of responsive teaching, with heavy loadings for dimensions such as teacher sensitivity, as well as the more domain-specific elements of cognitive facilitation. Thus, the bifactor approach draws attention to a broader set of interactions that are important for facilitating children's language environment than have been shown in prior studies (e.g., Mashburn et al., 2008), likely in large part due to limitations of including very highly correlated CLASS domain scores in single predictive models.

When examining the prediction of gains in children's inhibitory control, assessed through the pencil tap procedure in this study, the interpretation from the three-factor approach is somewhat confounding. As hypothesized, children gained greater inhibitory control skills in classroom that were more organized—with stronger management and routines. However, contrary to hypotheses or the existing literature (e.g., Mintz, Hamre, & Hatfield, 2011), there was also a negative association between emotional support and inhibitory control. In contrast, the bifactor model suggests that only positive management and routines is associated with growth in inhibitory control. These results conform much more clearly to theory and prior evidence (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009) and again suggest that issues of shared variance complicated the interpretation of results using the three-factor approach.

Findings related to children's relationships with teachers were somewhat mixed. The bifactor model suggests that children in classrooms with more responsive teachers decline in teacher-reported conflict from fall to spring. However, there was no association between any of the bifactor domains and the development of teacher–child closeness. In contrast, the three-factor approach does not provide evidence of any association between teacher–child interactions and children's conflict with teachers, a finding that is inconsistent with prior research showing associations between emotional support and conflict (e.g., Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008). Surprisingly, and in contrast to prior work, these results suggest a small role of instructional support for promoting close relationships with teachers. Overall, the findings related to children's relationships with teachers seem most unclear and may be confounded, in part, by the use of teacher-report data, as well as above-noted issues related to multicollinearity. Future work including observational measures of student–teacher relationships may provide a clearer pattern of results.

Implications

Taken together these results suggest some advantages stemming from each approach. The simplicity of the traditional three-factor approach, from analytical, conceptual, and practical standpoints, is a clear advantage. Given that the Office of Head Start and several states are using these factor scores as a part of monitoring and quality improvement systems, modification to the factor structure could complicate policy initiatives. And a series of professional development approaches, including an online coaching model (Downer et al., 2012) and an in-person college course (Hamre et al., 2012), have demonstrated the value of this conceptualization of teacher–child interactions from the perspective of helping teachers change their practices. Certainly there is a need for further study and replication prior to any changes being made at the policy level.

These results do help illuminate current debates regarding how much early childhood teachers should focus on providing emotionally supportive classrooms versus focusing on instructional interactions (Scott-Little, Kagan, & Frelow, 2006). In the context of increased pressure in Head Start and state prekindergarten programs to demonstrate academic outcomes, findings suggesting the prominent role for instructional support in predicting these outcomes have shifted many early childhood programs to intensively focus on these instructional elements of teaching practice (Beach, 2013). But an exclusive focus on instruction fails to adequately reflect the true nature of early childhood teachers' contributions to children's learning. The responsive teaching factor predicted outcomes across all domains in this study, including literacy and language. Given that this factor is composed heavily of elements of teaching such as teacher sensitivity, positive relationships, and support for children's autonomy, an exclusive focus on the instructional support dimensions of CLASS may fail to have as meaningful an effect on children's development as a more balanced approach.

The greatest appeal of the bifactor approach is in the increased clarity of interpretation due to the lack of multicollinearity. Thus, the implications at this point may be greatest for other researchers using CLASS. To this end, it will be important to know if the bifactor approach can be replicated in other samples, both in terms of the fit of the structural model and in predicting children's development. Researchers will need to decide on the best strategy for generating bifactor scores. Some approaches to generating these scores will emphasize strong fit *within* studies (e.g., each study creating its own bifactor model), whereas others place a greater emphasis on generalizability *across* studies (e.g., providing suggested loadings for the three factors and syntax to compute these scores).

Limitations and Future Directions

Caution is warranted in interpretation of these findings until they are replicated across studies. In addition, theory development requires corroboration using multiple methods and measures; thus, similar work using other measures of teacher–child interactions is important. Relatedly, it is important to note that the CLASS focuses on teacher–child interactions that are measured across content areas such as math, science, and language arts. Future research in which the CLASS is supplemented with content-specific observational measures (e.g., Sarama & Clements, 2009) may provide valuable additional information regarding the ways in which these practices load on more general or domain-specific factors.

A major limitation of all research using the CLASS and other observational measures of classrooms is the relatively low magnitude of associations with children outcomes. Recent work in classrooms with older children suggests significant variance in observed teacher effectiveness across days, suggesting there would likely be value in observing teachers for more days (Kane & Staiger, 2012). In addition, despite significant efforts toward training and calibration of raters, significant rater variance remains in studies using the CLASS (Mashburn, Downer, Rivers, Brackett, & Martinez, 2013). Although agreement among raters was acceptable within this study, finding ways to increase rater precision or increasing the number of raters per classroom may provide more accurate assessments of teacher–child interaction quality. The resulting increases in precision of measurement may improve the magnitude of predictive associations (Mashburn et al., 2013). There is also a need to look for other elements of classrooms and classroom interactions that contribute to children's development (Zaslow, Martinez-Beck, Tout, & Halle, 2011).

Summary

In sum, this study suggests the value of conceptual and analytic approaches that elucidate both general and domain-specific elements of teachers' daily interactions with children. Similar work has been accomplished with a bifactor model of attention deficit hyperactivity disorder (ADHD; Martel et al., 2010). This work has afforded clarity in the behavioral structure, diagnosis, and comorbidity of the disorder, identifying a general ADHD symptom factor and two specific factors of inattentive symptoms and hyperactive-impulsive symptom. Similar advantages may be achieved through use of this analytic method in studies of adult–child interactions. This work can help refine our knowledge regarding how teachers contribute to children's development as well as support the development of more targeted and effective interventions.

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