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The Relation Between Teachers' Positive Behavior Support and Language Support

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Abstract

The goal of this study was to extend what is known about factors that contribute to the language-learning environment in early childhood classrooms. Two primary research questions were addressed: (a) Are measures of teacher use of classroom-wide positive behavior intervention and support (PBIS) strategies associated with the quality of teacher language support? and (b) Do teachers who receive program-wide training in PBIS strategies differ in their language interactions with children in their classrooms compared with a control group? Findings were mixed and provide preliminary support for the hypothesis that a positive relationship exists between PBIS strategies and the language-learning environment of preschool classrooms. Teachers' scores on a measure of PBIS strategies were a significant predictor of global ratings of language support. However, teachers who were enrolled in the program-wide PBIS training group did not score significantly higher than teachers in a control group at posttest.

Keywords

environment, language/communication, caregiver–child interaction

Language abilities are related to the development of social skills, relationships with peers, and self-regulation (Clegg et al., 2014; Cohen & Mendez, 2009; Rescorla et al., 2007; Roben et al., 2013). Children with stronger language skills also have significantly better scores on measures of listening and reading comprehension, letter identification, and decoding skills in the early elementary grades (Duff et al., 2015; Lee, 2011; Sénéchal et al., 2006). Conversely, children who exhibit language delays at the end of preschool and beginning of kindergarten have persistently lower reading skills compared with their age-matched typically developing peers (Skibbe et al., 2008). The deficits associated with delayed early language can persist even into adolescence (Rescorla, 2009). Thus, identifying ways to promote language development in young children is a critical area of focus in the field of early childhood education (ECE).

More than 60% of young children between the ages of 3 and 5 years are enrolled in childcare and preschool classrooms (U.S. Department of Commerce, Census Bureau, 2018), making ECE classrooms natural contexts for targeting early language development. However, research indicates that, on average, the quality of language support in childcare settings is low (Justice et al., 2008; Wasik et al., 2006). Researchers have examined the effects of language-focused professional development (PD) to enhance teacher language support in classrooms (Landry et al., 2011; Piasta et al., 2012; Wasik et al., 2006). In this line of research, the critical question examined was the extent to which the intended "cascading" effect occurs: Do teachers implement strategies with sufficient dosage and fidelity, and do child language skills increase as a result of teachers' implementation?

In a narrative review of language-focused PD studies, Dickinson (2011) concluded that the results of these teacher-level interventions on child language outcomes are variable, and often null. These conclusions are supported by a meta-analysis of the impact of PD interventions on child language outcomes. Markussen-Brown et al. (2017) conducted a meta-analysis examining the effects of language- and literacy-focused PD interventions on language outcomes for young children. The authors found statistically significant effects on phonological awareness and alphabet knowledge but did not find significant effects for vocabulary. Dickinson (2011) hypothesized two reasons why PD interventions fail to produce clinically meaningful changes in child oral language outcomes: (a) The amount of time teachers spend engaging in language promoting practices is not sufficient for improving children's skills and (b) the strategies require teachers to modify multiple features of their language interactions with children, which can be

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challenging. This is reflected in findings from PD studies that show teachers had low adherence to language facilitating strategies (Dickinson, 2011; Mendive et al., 2016; Pence et al., 2008).

In the PD literature, teacher training has typically focused on specific teacher skills related to promoting language development. However, teacher–child language interactions do not occur in isolated one-on-one settings; teachers interact with multiple students across the school day within complex classroom environments. Teachers are responsible for addressing child development goals in multiple domains, managing and training support staff members, and maintaining the physical and temporal environment of their classroom (Doyle, 2013). From an ecological perspective, these features of the classroom environment interact with individual child and teacher characteristics to produce the context in which learning occurs (Bronfenbrenner, 1994; Downer et al., 2010). Few studies have examined how features of instructional models, classroom organization, or teacher management of child behavior influence teacher–child interactions and enhance or inhibit children's language learning.

Downer et al. (2010) argue that research on classroom interventions needs to extend beyond examining teacher and child variables within a single domain of development to include analysis across domains of development. Similarly, in a systematic review of multicomponent interventions, Offer-Boljahn et al. (2019) highlight the importance of considering the robust evidence that suggests development is often connected across domains of learning in young children, and that the complexities of child development should be considered when evaluating classroom-based interventions. Given their strong associations, this might be particularly true for children's challenging behavior and delayed language development. There is evidence that young children who exhibit challenging behavior are significantly more likely to experience delays in language and literacy development, as compared with peers without challenging behavior (Bichay-Awadalla et al., 2020; Campbell, 1995; St Clair et al., 2019). This cooccurrence can persist into later childhood and early adolescence, highlighting the need for early support (Lindsay & Dockrell, 2012; St Clair et al., 2011, 2019).

We examined the relation between two components of teacher behavior that provide essential support for children's development: (a) use of language support strategies and (b) use of positive behavior intervention support (PBIS) practices. Features of quality language support include (a) responsiveness to child communication (Girolametto & Weitzman, 2002; Justice et al., 2018); (b) following children's lead in conversations and expanding child language to model new forms (Cleave et al., 2015; Roberts & Kaiser, 2015; Wasik et al., 2006); (c) use of strategies that scaffold, encourage and elicit language and support longer conversations (Pentimonti et al., 2017; Wasik et al., 2006; Wasik & Hindman, 2011); and (d) modeling complex vocabulary and sentence structures (see Hoff, 2003; Huttenlocher et al., 2002).

Broadly, PBIS refers to a tiered approach for supporting prosocial development and preventing challenging behavior in educational settings (Sugai et al., 2000). The Pyramid Model (Hemmeter et al., 2007, 2016) is a PBIS framework implemented in ECE and is designed to support children's behavior and social–emotional development through PBIS practices including (a) communicating clear behavior expectations, (b) providing reinforcement for prosocial behavior, (c) organizing the physical and temporal environment to maximize engagement, (d) providing explicit instruction on prosocial skills, and (e) providing individualized supports for children with persistent challenging behavior (Hemmeter et al., 2016).

There is emergent evidence of a positive association between teachers' use PBIS practices and management strategies in their classrooms and student gains in both academic performance and language skills in the preschool (Dobbs-Oates et al., 2011). One explanation for these related outcomes may be that children with better prosocial skills tend to have greater academic success; therefore, teachers using strategies that support children's prosocial behavior development may also influence children's positive academic outcomes (Caprara et al., 2000; Downer et al., 2010; Malecki & Elliot, 2002; Nix et al., 2013). Another potential pathway for this linkage is that teacher use of PBIS practices increases positive teacher–child language interactions and subsequently creates more language learning opportunities (Chow et al., 2020; Downer et al., 2010). However, there are no published studies that specifically analyze the relation between teachers' use of PBIS practices the quality of their language support.

Guided by the ecological systems perspective (Bronfenbrenner, 1994; Doyle, 2013) and the cross-domain development theory proposed by Downer et al. (2010), we hypothesized that the use of PBIS practices influences the duration and frequency of high-quality teacher–child language interactions indirectly through changes in both teacher and child behaviors. PBIS practices can improve child behavior by strengthening prosocial skills, increasing engagement, and decreasing challenging behavior (Duda et al., 2004; Hemmeter et al., 2016). We hypothesized that teachers who implement PBIS strategies spend less time responding to challenging behavior and reengaging children, allowing them more time to engage in instruction, play, and conversations with children. We addressed the following questions:

1. Is teacher use of PBIS practices associated with the quality of teacher language support provided to children in the classroom?

Table 1. Teacher Participant and Classroom Characteristics (Study 1; *N* = 51 Teachers).

Characteristic	Descriptive Statistic
Gender	100% female
Mean years of experience (range)	14.25 (0–47)
Education	20% HS 30% AA/CDA 30% Bachelor's 20% Master's
Mean number of children per classroom (range)[a]	14.09 (4–26)
Percentage of classrooms with at least one child with language delay[b]	33.3
Percentage of classrooms with at least one dual language learner[b]	64.7
Mean CLASS emotional support score (range)	5.66 (3.13–6.69)
Mean CLASS classroom organization score (range)	4.98 (2.5–6.58)
Mean CLASS instructional support score (range)	2.32 (1–4.58)

Note. HS = high school; AA = associate's degree; CDA = child development associate degree; TPOT = Teaching Pyramid Observation Tool; CLASS = Classroom Assessment Scoring System.
[a]Present during the TPOT observation. [b]As reported by the teacher during the TPOT observation.

2. Do teachers who receive training in PBIS practices differ in their language interactions with children in their classrooms compared with teachers who do not receive training?

We hypothesized that teachers who score higher on a measure of PBIS practices would be significantly more likely to also demonstrate higher quality language support in their interactions with children. We hypothesized that teachers who participated in Pyramid Model training to enhance the use of PBIS practices would have higher scores on a measure of quality language support at posttest, compared with teachers who were assigned to a business as usual (BAU) control group.

Method

We conducted (a) an observational study, utilizing a correlational design, to explore the relation between PBIS and teacher language support and (b) a secondary analysis of data collected during a randomized control trial (RCT) to examine the effects of a program-wide implementation of the Pyramid Model on the quality of teacher language support.

Study 1

Participants and setting. Data from a total of 51 teacher participants in 15 different childcare centers were analyzed for Study 1. Five centers were Head Start centers ($N = 15$ teachers), five were centers serving middle- to low-income communities ($N = 19$ teachers), and five were centers serving children from predominantly middle- to high-income backgrounds ($N = 17$ teachers). Demographic teacher and classroom data can be found in Table 1. All participants were lead teachers. There were no instances in which two teachers from the same classroom participated. The classrooms served preschool-aged children (3–5 years). Thirty-nine of the 51 teacher participants were concurrently enrolled in the Program Wide Pyramid Model study described below in Study 2. For the 39 teachers who were also enrolled in the RCT, observational data for Study 1 were collected at pretest (i.e., before any PBIS coaching occurred). Twelve teachers participated in Study 1 observational data collection at one time point only and were not enrolled in the RCT.

Data collection procedures. Variables collected in Study 1 included (a) observational ratings of use of PBIS practices (Teaching Pyramid Observation Tool, TPOT; Hemmeter et al., 2014) and (b) observational rating of teacher language support (Language Modeling [LM] subscale of the *Classroom Assessment Scoring System* [CLASS, Pianta et al., 2008]).

Positive behavior support. Teachers' use of PBIS practices was assessed using the TPOT (Hemmeter et al., 2014). The subscales of the assessment include (a) Key Practices, which include items related to the use of PBIS strategies in the classroom such as effective transitions, providing clear expectations, and explicitly teaching prosocial skills and (b) Red Flags, which include items related to problematic practices such as using harsh reprimands, negative language and classroom disorganization. TPOT assessments are based on approximately 90 to 120 min of observation in a single day and an interview with the lead teacher lasting approximately 20 min. The TPOT Key Practices score is reported as the percentage of total key practices indicators (114 possible indicators) observed or noted during the interview. The Red Flag score is reported as the percentage of

total Red Flag items ($k = 17$) present. Higher Key Practices scores reflect frequent use of PBIS practices, while higher Red Flag scores reflect use of negative practices. All TPOT assessors were trained to reliability though a standardized training program.

Per the observation manual, previous evaluations of the TPOT indicate inter-rater reliability is greater than 0.89 for scores assigned on the Key Practices Subscale and greater than 0.84 for scores assigned on the Red Flags subscale. Significant correlations between the TPOT subscales and the subscales of the *Early Childhood Environmental Rating Scale–Revised* (ECERS-R, Harms et al., 2005), indicate strong construct validity. The authors of the TPOT report a moderate correlation (0.55, $p < .01$) between the TPOT Key Practices subscale and the overall ECERS-R Score and a moderate and negative correlation (−0.53, $p < .01$) between the TPOT Red Flag scores and ECERS-R overall quality scores (Snyder et al., 2013).

Reliability observations were conducted in 17 classrooms (randomly selected). The total number of agreements (on the presence or absence of TPOT indicators) was divided by the total number of agreements plus disagreements and multiplied by 100. In instances ($N = 2$) in which it was not possible for two observers to conduct the TPOT observation together live, reliability was scored via video. Average inter-rater reliability was 83.98% (range = 78%–90%).

Quality of teacher language support. The LM subscale of the CLASS (Pianta et al., 2008) was used to assess the overall quality of teacher language support. The CLASS is designed to assess the overall quality of the classroom environment in terms of emotional support, classroom organization, and instructional support. The CLASS requires a 2-hr observation, divided into four 30-min cycles in which an observer observes the classroom for 20 min and scores for 10 min. Observers assign a rating for each of the subscales; scores range from 1 (indicating lowest quality) to 7 and are averaged across cycles. On the LM subscale, indicators of high-quality language modeling include frequent conversations among children and teachers, frequent use of strategies that support child expression, and modeling of sophisticated vocabulary. The CLASS demonstrates strong internal reliability, with across cycle coefficients ranging from 0.79 to 0.91 across test subdimensions (Pianta et al., 2008). The subscales of emotional and instructional support (which includes the LM Subscale) are significantly correlated with the total scores of the ECERS-R, with coefficients of 0.52 and 0.40, respectively (LaParo et al., 2004).

All observers attended a CLASS certification course and passed the online reliability test. Most observations were conducted live. Due to scheduling limitations, four of the 51 observations were scored from video that was recorded during the live TPOT observations. Per the observation coding manual, observations from video recording are acceptable (Pianta et al., 2008). Reliability observations were conducted in 16 classrooms (randomly selected). Agreement on the CLASS is defined as two observers scoring an item within ±1 point of each other. Average interobserver agreement (IOA) on the full measure (including all 10 subscales) was 90.23% (range = 67.5–100). Average IOA on the LM subscale was 95% (range = 50–100). IOA on the LM subscale was 100% for 14 of the 16 reliability observations.

Blind observers. All observers were blind to study condition for the RCT. However, not all observers were naïve to the purpose of the study. The first author conducted both TPOT and CLASS observations in seven classrooms. Reliability checks were conducted regularly, minimizing the potential for bias.

Analysis. SPSS was used to conduct all analyses. The unit of analysis was individual teacher/classrooms. This sample is hierarchical in nature, given that the 51 teachers were nested in 15 childcare centers. On average, there were three to four participating teachers in each center (range = 1–7). We would expect that some of the variance in teacher CLASS scores can be attributed to the fact that teachers at one center may tend to score more similar to each other than teachers at a different center, which can introduce error into the analysis (Hox, 1998). The first step in the analysis was to calculate an intraclass correlation coefficient (ICC) to determine if a portion of the variance could be attributed to differences at the center level. The ICC for the CLASS LM outcome variable was 0.40. ICC values above 0 indicate that a portion of variance in outcomes can be attributed to covariation at the cluster level. Multilevel regression was used to control for this. Teacher attainment of a college degree was a significant predictor of CLASS LM scores and was included in the model. Allowing the TPOT score slope to vary randomly did not result in a significant contribution to the overall variance; as such a random intercept with fixed slopes model was utilized:

$$\begin{aligned}
\text{LMScore}_{ij} &= \beta_{0j} + \beta_{1j}(\text{TPOTscore})_{ij} + \\
&\qquad \beta_{2j}(\text{College Degree})_{ij} + e_{ij}, \\
\beta_{0j} &= \gamma_{00} + u_{0j}, \\
\beta_{1j} &= \gamma_{10}, \\
\beta_{2j} &= \gamma_{20}.
\end{aligned}$$

In this model, "LMScore" represents the teachers' score on the LM subscale of the CLASS (the primary outcome variable); "TPOTscore" represents the teachers' Key Item score on the TPOT and "College Degree" represents the dichotomous covariate entered into the model indicating if a teacher had attained a college degree.

Table 2. Teacher and Classroom Characteristics (Study 2).

Characteristic	Whole sample ($N = 35$)	Intervention ($n = 20$)	Control ($n = 15$)
Teacher education	26% HS 31% AA/CDA 29% BA/BS 14% Master's	25% HS 30% AA/CDA 20% BA/BS 25% Master's	27% HS 33% AA/CDA 40% BA/BS 0% Master's
Mean years of teacher experience (range)	14.4 (0–47)	15.3 (0–47)	13.2 (0–40)
Mean number of children per classroom (range)[a]	13.2 (6–29)	11.6 (6–18)	15.8 (8–29)
Percentage of classrooms with at least one child with LD[b]	17.1	20	13.3
Percentage of classrooms with at least one DLL[b]	17.1	10	26.7
Mean baseline CLASS scores			
Emotional support	5.75	5.73	5.77
Classroom organization	5.11	5.0	5.22
Instructional support	2.15	2.12	2.17

Note. HS = high school; AA = associate's degree; CDA = child development associate degree; BA/BS = bachelor of arts/science; LD = language delay; DLL = dual language learner; TPOT = Teaching Pyramid Observation Tool; CLASS = Classroom Assessment Scoring System.
[a]Present during the TPOT observation. [b]As reported by the teacher during the TPOT observation.

Study 2

Study 2 was designed to extend findings from Study 1 by examining how teachers in centers randomized to receive program-wide support around implementing the Pyramid Model differed in terms of language support from teachers in centers who were not receiving that support. Ten childcare centers (with a total of 35 participating teachers with posttest data available) were randomized to receive program-wide support and training on the Pyramid Model or to a BAU control group. Five centers (with 20 teachers) were randomly assigned to the intervention group and five centers (with 15 teachers) were randomly assigned to the control group. The total number of teachers in the intervention and control condition is unequal because randomization was conducted at the center level not the teacher level.

Participants and setting. Posttest data from 35 teachers (20 Pyramid; 15 BAU) were analyzed in Study 2. Summary characteristics for teachers and classrooms in Study 2 are shown in Table 2. On average, there were three to four participating teachers in each center (range = 1–6).

Program-wide Pyramid Model intervention. The Pyramid Model is a tiered intervention framework that focuses on preventing challenging behavior and promoting social and emotional development in ECE classrooms (Hemmeter et al., 2007, 2016). Teaching practices for nurturing relationships and providing a supportive classroom environment constitute Tier 1 for universal promotion of prosocial behavior. The second tier focuses on explicit instruction to address prosocial skills including skills for emotional regulation, friendship, and problem-solving. The third tier centers on strategies for intervening with children who display more persistent challenging behavior. At each tier, supportive relationships between teaching staff and families are emphasized.

Teachers assigned to the intervention group taught in centers that were receiving support to implement the Pyramid Model program wide (Program-wide Supports for Pyramid Model Implementation [PWS-PMI]). In this approach, members of the research staff provided external coaching support to a leadership team (consisting of individuals who served in the roles of administrator, classroom coach, behavior support specialist, and teacher) at each participating childcare/preschool center. The leadership team engaged in initial workshop trainings, and then external research team coaches helped leadership team members provide ongoing PD to center staff, including practice-based coaching (Snyder et al., 2015) to teachers around Pyramid Model practices, facilitating development of individualized behavior support plans, monitoring fidelity of implementation, and supporting family involvement. External coaches attended one leadership team meeting per month and visited each center weekly.

The PWS-PMI intervention occurred from August through April (approximately 9 months). Research staff provided initial training and ongoing technical assistance to the leadership team at each intervention site at the beginning of and throughout this period. The implementation of each component of the intervention approach was measured across the intervention period. Adherence to the workshop training protocols was monitored and procedural fidelity was above 90% for all trainings with the exception of one staff training. In addition, external coaches maintained logs of the content and strategies used in the monthly leadership team meetings and weekly coaching visits. On average, coaches attended 9.6 leadership team meetings at each center over the course of the coaching period (range = 9–10 meetings). These meetings included: (a) reviewing and updating the team implementation plan (average of $N = 7$ meetings); (b) providing support around collecting and analyzing child behavior incident reports (average of $N = 4$

meetings); (c) reviewing and analyzing the center's *Early Childhood Benchmarks of Quality* (Fox et al., 2017), a tool for self-monitoring critical elements of quality program-wide PBIS strategies; and (d) providing support for data and fidelity of implementation monitoring and interpretation (average of $N = 4$ meetings). External coaches completed an average of 26 weekly coaching meetings at each center (range = 18–36). Across centers, the most frequent supports included: (a) coaching in the classroom alongside the internal coach; (b) discussing and reviewing coaching strategies and implementation with the internal coach; (c) providing behavior support; and (d) providing data support. Other types of support included the external coach providing coaching in the classroom without the internal coach, conducting a TPOT with the internal coach, and assisting with family events. On average, external coaches self-reported that they completed 76% of protocol items (range = 18–100).

Data collection procedures. TPOT and CLASS data were collected pre- and posttraining as a part of the RCT. As with Study 1, teacher PBIS was measured using the TPOT key items score, and quality of teacher language support was measured using the LM subscale of the CLASS. All observations used in the Study 2 analysis were conducted in vivo. Reliability observations were conducted in approximately 10% of the classrooms at posttest ($N = 4$). Average agreement for the posttest TPOT observations was 86.55% (range = 79.55–93.94). Average agreement for the posttest CLASS observations was 93.13% (range = 87.50–100.00). Average agreement for the posttest CLASS LM subscale was 87.5% (range = 50–100).

Analysis. As in Study 1, the ICC was calculated to determine if multilevel modeling was required. The ICC for posttest CLASS LM scores (the primary outcome measure for Study 2) was 0.48. Thus, a multilevel regression model was used to determine if participating in the PWS-PMI intervention group significantly predicted posttest CLASS LM scores. Three Level 1 predictors were entered into the model, with posttest LM scores as the primary outcome variable: (a) a dichotomous variable representing inclusion in the Pyramid Training versus BAU group, (b) baseline CLASS LM score, and (c) a dichotomous variable representing whether or not the teacher had obtained a college degree (retained in this model to be consistent with the analysis conducted in Study 1). The following model was used:

$$\begin{aligned}\text{PostLMScore} &= \beta_{0j} + \beta_{1j}(\text{Pyramid Training})_{ij} + \\ &\quad \beta_{2j}(\text{PreLMScore})_{ij} + \\ &\quad \beta_{3j}(\text{College Degree})_{ij} + e_{ij},\\ \beta_{0j} &= \gamma_{00} + u_{0j},\\ \beta_{1j} &= \gamma_{10},\\ \beta_{2j} &= \gamma_{20},\\ \beta_{3j} &= \gamma_{30}.\end{aligned}$$

In this model, "PostLMScore" represents the teacher's score on the LM subscale of the CLASS at posttest (primary outcome variable), "Pyramid Training" represents the dichotomous predictor variable indicating whether or not a teacher was assigned to participate in PWS-PMI, "PreLMScore" represents the teacher's score the LM subscale of the CLASS at pretest, and "College Degree" represents the dichotomous covariate entered into the model indicating if a teacher had or had not attained a college degree or higher.

In addition to the primary analysis described above, we also analyzed the extent to which participation in the PWS-PMI experimental group affected teachers' use of PBIS (i.e., TPOT scores) to more fully describe the dataset and the effects of Pyramid training. For this analysis, the following model was used:

$$\begin{aligned}\text{Post TPOT} &= \beta_{0j} + \beta_{1j}(\text{Pyramid Training})_{ij} + \\ &\quad \beta_{2j}(\text{Pre TPOT})_{ij} + \\ &\quad \beta_{3j}(\text{College Degree})_{ij} + e_{ij},\\ \beta_{0j} &= \gamma_{00} + u_{0j},\\ \beta_{1j} &= \gamma_{10},\\ \beta_{2j} &= \gamma_{20},\\ \beta_{3j} &= \gamma_{30}.\end{aligned}$$

Results

Descriptive Analysis (Study 1)

The average TPOT Key Practices score across the 51 participating teachers was 50.37 ($SD = 14.4$; range = 23.01–90.27). This score indicates that approximately half of the indicators represented on the TPOT key practice items subscale were observed in these classrooms. The average TPOT Red Flag score was 2.41 ($SD = 3.16$) The average CLASS LM subscale score was 2.75 ($SD = 0.83$; range = 1–4.75). This score indicates that, on average, teachers' language support fell in the low-quality range. No significant differences were found on either of the primary variables (TPOT, CLASS LM) between teachers from centers serving children from low-income backgrounds and centers serving primarily children from middle to upper income backgrounds.

Multilevel Regression Outcomes (Study 1)

Results from the multilevel regression can be found in Table 3. Results indicated that teachers with higher TPOT scores were significantly more likely to score higher on the CLASS LM subscale ($\beta = 0.03$; $p = .003$). For every 1 point increase on the TPOT, the model predicted a 0.03 point increase on CLASS LM subscale scores.

Table 3. Multilevel Regression Results for CLASS LM Scores (Study 1).

Fixed effects					
Parameter	Estimate	*SE*	*t*	*p* value	95% CI
Intercept	1.26	0.40	3.16	.003	[0.45, 2.07]
TPOT	0.03	0.01	3.19	.003	[0.01, 0.04]
Advanced degree	0.26	0.24	1.09	.284	[−0.23, 0.74]
Random effects					
Parameter	Estimate	*SE*	Wald *Z*	*p* value	95% CI
Residual	0.48	0.11	4.15	.00003	[0.30, 0.77]
Program	0.01	0.07	0.220	.826	[0.00, 107.85]

Note. CLASS = Classroom Assessment Scoring System; LM = Language Modeling; CI = confidence interval; TPOT = Teaching Pyramid Observation Tool.

Table 4. Descriptive Outcomes From Pyramid Model RCT.

Measure	Unadjusted pretest, *M* (*SD*)	Unadjusted posttest, *M* (*SD*)
TPOT key items (whole sample)	47.29 (11.45)	51.40 (14.47)
Intervention group (*N* = 20)	46.32 (12.78)	54.90 (14.6)
Control group (*N* = 15)	48.57 (9.65)	46.73 (13.35)
CLASS LM Score (whole sample)	2.54 (0.69)	2.81 (0.82)
Intervention group (*N* = 20)	2.53 (0.79)	2.91 (0.91)
Control group (*N* = 15)	2.57 (0.56)	2.68 (0.70)

Note. RCT = randomized controlled trial; TPOT = Teaching Pyramid Observation Tool; CLASS = Classroom Assessment Scoring System; LM = Language Modeling.

Descriptive Analysis (Study 2)

Means and standard deviations for the measures obtained at pre- and posttest can be found in Table 4. The average, unadjusted posttest TPOT score for the 35 teachers who completed the PWS-PMI study was 51.40 (*SD* = 14.47; range = 15.79–87.50). To evaluate the effects of the PWS-PMI on teachers' TPOT scores at posttest, a multilevel regression was conducted which controlled for baseline TPOT scores and teacher college degree attainment. Based on results from this model, teachers employed at programs randomized to receive PWS-PMI scored, on average, 11.4 points higher on the TPOT than teachers assigned to BAU control group (when controlling for pretest TPOT scores and college education); this finding approached significance ($p = .069$).

Posttest Analysis of CLASS LM Scores

The average unadjusted posttest LM CLASS score for the full sample was 2.81 (*SD* = 0.82; range = 1.75–5.25). The unadjusted average LM CLASS score for teachers in the intervention group was 2.91 (*SD* = 0.91), and the unadjusted average score for teachers in the control group was 2.68 (*SD* = 0.70). Results of the multilevel regression analysis of teachers' posttest CLASS LM scores can be found in Table 5. Results indicated that teachers in the intervention group scored, on average, 0.38 points higher on the CLASS LM subscale than the control group when controlling for pretest CLASS LM scores and college education. This finding was not statistically significant ($p = .332$).

Discussion

The purpose of these studies was to extend what is known about factors contributing to the language-learning environment in ECE classrooms. First, we used a correlational design to examine the relation between measures of teacher use of PBIS strategies (as measured by the TPOT) quality of language support (as measured by the LM subscale of the CLASS). Teachers' scores on the TPOT were a significant predictor of the quality of language support they provided in the classroom. Second, we used data from an experimental study to examine the effects of a PD intervention focused on increasing teacher use of PBIS strategies, on the quality of teacher language support. Findings from the posttest analysis of the CLASS LM scores suggest that teachers in the intervention group, on average, demonstrated a slightly higher quality of language support at posttest compared

Table 5. Posttest Analysis of CLASS LM Scores (Study 2).

Fixed effects					
Parameter	Estimate	*SE*	*t*	*p* value	95% CI
Intercept	1.84	0.56	3.30	0.003	[0.69, 2.99]
College degree	0.388	0.27	1.44	0.16	[−0.16, 0.94]
Baseline LM	0.20	0.20	1.029	0.31	[−0.20, 0.61]
Pyramid Model	0.38	0.36	1.046	0.33	[−0.49, 1.25]
Random effects					
Parameter	Estimate	*SE*	Wald *Z*	*p* value	95% CI
Residual	0.42	0.12	3.39	0.001	[0.23, 0.74]
Program	0.19	0.18	1.065	0.287	[0.03, 1.21]

Note. LM = Language Modeling; CLASS = Classroom Assessment Scoring System; CI = confidence interval.

with teachers in the BAU control group; however, this difference was not statistically significant. Although the average intervention group scores on the CLASS LM were higher than the BAU group, the average posttest score of the intervention group (2.91) would be classified as low-quality language support. PWS-PMI training was not sufficient to enhance teacher language support to a level of quality which likely would be needed to meaningfully affect child outcomes. Research indicates CLASS scores of moderate quality or higher on Instructional Quality domain (in which the LM subscale is included) are needed to influence children's academic outcomes (Burchinal et al., 2010).

Taken together, the findings provide tentative support of the hypothesis that the organizational/social–emotional environment of a classroom would be related to the overall quality of language support afforded to children in the classroom. However, given the nonsignificant effects of the Pyramid Model on teacher language quality, we cannot draw strong conclusions about the causal mechanism for change. While we hypothesize that the teachers' use of PBIS strategies "set the stage" for more frequent language-learning opportunities via a reduction in time spent responding to challenging behavior, it could be that the process proceeds in the opposite direction, such that the level of teacher language support influences the extent to which PBIS strategies are utilized. It is also possible that the relation is more dynamic in nature, such that increased use of PBIS practices leads to decreased challenging behavior and increased high-quality conversations and, in turn, this supports sustained child engagement, further limiting challenging behavior, and increasing opportunities for conversation.

Implications for Research and Practice

The ecological perspective grounding the hypotheses evaluated in this project states that characteristics at the classroom environment, teacher, and individual child level interact to form the learning environment (Bronfenbrenner, 1994; Doyle, 2013). This implies that learning opportunities in the classroom are the result of teachers' instructional skills interacting with multiple contextual variables, and with child characteristics and behaviors such as engagement. This perspective may be especially important for classroom-based language interventions that are conversation-based. Many of the PD interventions included in the language outcomes meta-analysis conducted by Markussen-Brown et al. (2017) trained teachers to embed language support strategies into ongoing conversations. In such interventions, it is expected that teachers will utilize language support strategies in the context of naturally occurring conversations, rather than (or in addition to) during discrete trials or scripted instructional activities. It is possible that teachers' ability to use naturally occurring opportunities to model and teach language, embed specific language modeling and instruction, and leverage interactions as language teaching events are influenced by variations in the classroom environment.

The findings from this analysis may offer a potential explanation for why some PD intervention studies have found that teachers have difficulty implementing language-focused interventions with high fidelity (Dickinson, 2011; Mendive et al., 2016; Pence et al., 2008). It is possible that the use of PBIS strategies moderates the effects of language-focused PD interventions, such that teachers who already exhibit strong organizational and PBIS skills are able to utilize the targeted language support and intervention strategies more frequently and perhaps with higher fidelity. The findings from this study offer some support for the development of more comprehensive models of PD that include teach teachers how to support both behavior and language and for the measurement of other contextual variables outside the instructional domain of interest when evaluating the outcomes of PD interventions.

Within the ecological model, it is also important to consider that other teacher-level factors may moderate the relation between use of PBIS practices and language support; these may include factors such as years of experience, level of education, self-efficacy, and knowledge of language development. In the current studies, teacher's level of education was controlled for in the analyses. However due to limited sample size, other potentially relevant teacher factors were not explored. Future research should examine the role that other teacher-level characteristics may play the relation between PBIS and language support provided by teachers in ECE classrooms.

The small, nonsignificant, positive effect of the program-wide Pyramid Model intervention on language quality could indicate that while improving teacher use of PBIS strategies may result in increased opportunities for high-quality language in teacher–child interactions, systematic coaching on targeted strategies for supporting language is still needed. We propose that a PD intervention that supports teachers in both language and social–emotional domains is needed to ensure that teachers have the skills for frequent, sustained, language-rich conversational and instructional interactions during the day. Coaching on specific linguistic and communicative strategies to be used in those interactions may be essential.

Future Directions

The outcomes from this study suggest more information is needed regarding the malleable aspects of PBIS practices that may drive the relation between these practices and the provision of language support. Future research should examine if changes in teacher use of specific PBIS strategies are more closely associated with the quality and frequency of conversational exchanges than others. With a larger sample it would be possible to determine if there are key items from the TPOT that are associated with changes in teacher language support. Future studies should examine these factors, as this information could be used identify specific high leverage PBIS strategies to target as the foundation of language-focused PD.

In addition, measurement of language using a broad, global tool such as the CLASS is a potential limitation in the current studies and should address in future research. While some studies have found significant associations between CLASS scores and child outcomes (see Mashburn et al., 2008), results from other analyses have not (see Justice et al., 2018). Possibly, a global measure of language environment is not sufficient to fully capture the language learning experiences of young children in a classroom environment. Further descriptive research is needed to analyze how features of classroom environment, child, and teacher characteristics interact to create the language learning environment. It is well established that early language is learned in dyadic interactions between adults and children; a full picture of language learning opportunities in the classroom must measure and analyze the contributions of both partners and in the case of classrooms, multiple pairings of teachers and children. (Adamson et al., 2020; Hoff, 2006; Snow, 1977). These features of dyadic teacher–child interactions are not explicitly captured in the CLASS LM subscale. Future research should also examine the provision of language support to individual children. The CLASS does not capture the differential experiences of individual children, but rather provides an "average" experience of all children. Differential distribution of teacher attention may be another key factor in understanding the inconsistent effects on child language outcomes found in many language-focused PD interventions. Supporting this theory is evidence that individual children have variable linguistic experiences in group care settings (Chaparro-Moreno et al., 2019; Pelatti et al., 2014).

It is important to consider the role that errors or variance in measurement from observer to observer could play in the results. While training requirements were in place prior to conducting live observations for the study and reliability was monitored, it is still possible that errors in coding the LM subscale introduced error into the analytic models particularly given the margin of error allowed in the reliability calculation of the CLASS subscales. Given the potential limitations of the measurement tool, it is important to interpret the current findings as exploratory. Future work is needed to replicate these findings with a larger sample, and also to extend the findings by multiple measures of the language-learning environment to ensure that all aspects of language interactions are validly captured, and that we are capturing dimensions of language support in a way that is sensitive to change.

Limitations

There are two important methodological limitations to consider when interpreting the results of the project. First, the sample sizes for the analyses, particularly for the experimental analysis, were small. The sample size for the experimental analysis was limited to the number of teacher participants at the research sites that had been randomized as part of the larger RCT. Although these findings should be interpreted as exploratory, they may be important for the development of future studies. It is also important to note that the implementation of coaching in the Pyramid Model in the larger RCT differs from the coaching reported in other published studies examining Pyramid (see Hemmeter et al., 2016). In this RCT, program-wide implementation was used; effect sizes for TPOT outcomes in previous studies that implement direct researcher-to-teacher coaching have been larger than what was found in the present sample using a program-wide approach (see Hemmeter et al.,

2016). It is possible that if larger gains on the TPOT occurred, there may have been larger posttest differences on the CLASS LM. The variability in coaching fidelity may also have contributed to smaller effects. Thus, it is possible that the change in teacher use of PBIS practices was not sufficient to influence use of language support strategies to the extent that significant differences could be detected.

An additional limitation was the inability to have naive observers for all observations. TPOT and CLASS were often collected by the same observer. This was an issue only when the observer was not naive to the purpose of this project, which was the case for the first author who conducted both observations for a small portion of classrooms ($N = 7$). Reliability checks were conducted on approximately 20% of all CLASS observations conducted by the first author, and average reliability was (88%), with minimal disagreements on the scoring of the LM subscale (two total disagreements across all observation cycles between the first author and a second observer).

Conclusion

The findings from this project generally support the hypothesis that a positive relation exists between the use of PBIS strategies and language support. However, given the small sample size and methodological limitations outlined above, it is important to interpret these findings as preliminary. The findings may be useful to researchers and practitioners in (a) understanding why teachers have difficulty implementing language strategies in their classrooms with sufficient fidelity to change child outcomes and (b) developing PD models that consider the influence that variables including quality PBIS have on the learning context within a classroom. Future studies should focus on examining additional classroom, teacher, and child-level characteristics that could contribute to this relation to further our knowledge about the contextual features that support or inhibit language learning in ECE settings.

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