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Classroom Quality and Academic School Readiness Outcomes in Head Start: The Indirect Effect of Approaches to Learning

In our effort to narrow the national school-readiness achievement gap, we must identify malleable and teachable domain-general skills (i.e., skills that cut across academic domains such as math, language, and science) that help children succeed in the classroom and beyond it. One of the most important but least studied of these is approaches to learning (Kagan et al., 1995). Head Start defines approaches to learning as "the skills and behaviors that children use to engage in learning" [U.S. Department of Health and Human Services (USDHHS), 2015]. Skills such as persistence, sustained focus, peer communication/collaboration, and openness to new and challenging experiences are fundamental for children while they navigate the early childhood classroom. For this reason, Head Start has designated approaches to learning as one of its five core school-readiness domains (USDHHS, 2015).

Preschool may be a critical time for the development of approaches to learning. For many children, it is their first formal school experience and they are dealing with a myriad of social, emotional, and academic challenges for the first time (Bulotsky-Shearer, Dominguez, & Bell, 2012; Welsh, Nix, Blair, Bierman, & Nelson, 2010). For example, it is in preschool that children generally have their first opportunities to begin building friendships, to collaborate with peers, to communicate and work through disagreements, to practice paying attention during structured lessons, and to face novel academic content that requires persistence and the willingness to try and sometimes fail. For these reasons, approaches to learning skills are vital for success in preschool classrooms. Unfortunately, although there is significant variation among children, on average, children from low-income families have lower approaches to learning skills compared

to their middle- to high-income peers (Fantuzzo, Gadsen, & McDermott, 2011; McDermott et al., 2011).

A breadth of studies demonstrate that approaches to learning predict children's academic school readiness outcomes (Bustamante, White, & Greenfield, 2017; Bustamante, White, & Greenfield, 2018; Li-Grining, Votruba-Drzal, Maldonado-Carreno, & Haas, 2010; McWayne, Fantuzzo, & McDermott, 2004). What is less known, however, is precisely how the relationship between approaches to learning and academic school readiness unfolds. A patchwork collection of studies yields potential evidence for several relevant pathways in the literature, all of which ultimately suggest that approaches to learning might play an indirect role as a skill set through which classroom quality improves child outcomes. To further explore this intriguing possibility, the current study used the nationally representative Family and Child Experiences Survey (FACES) dataset, 2009 cohort, to begin to untangle whether approaches to learning might indirectly affect the relation between classroom quality and academic school readiness in a large, nationally representative sample of children in Head Start preschools. Below, we systematically explain the evidence of this pattern of associations.

Classroom Quality and Academic School Readiness

Fundamental to many large-scale education policies and interventions is the assumed connection between measures of classroom quality and child academic school readiness outcomes. There is evidence for this relationship, as many studies have demonstrated that, when exposed to classrooms of higher quality, children make greater gains in academic readiness, including math, phonological awareness, print knowledge, and vocabulary (Blankson, & Blair, 2016; Hatfield, Burchinal, Pianta, & Sideris, 2016; Mashburn et al., 2008; Williford, Maier, Downer, Pianta, & Howes, 2013; Zaslow, Burchinal, Tarullo, & Martinez-Beck, 2016). Much of

this work has employed the Classroom Assessment Scoring System (CLASS), a gold-standard measure of classroom quality, to gauge global quality and teacher-child interactions in three domains (Pianta, La Paro, & Hamre, 2008). *Emotional support* captures the extent to which the classroom is a warm, kind environment; teachers are aware of and responsive to children's needs; and educators support children's autonomy and expression. *Classroom organization* captures whether teachers provide clear behavioral expectations and redirect misbehavior, engage students in activities and minimize disruptions, and facilitate children's interest and involvement in learning. Finally, *instructional support* captures the teachers' efforts to develop children's higher order thinking skills and deepen their understanding of concepts, provide high-quality feedback that encourages children to explain their thinking, and encourage frequent conversation, including through sophisticated language and open-ended questions. This dimension of the CLASS is most closely associated with children's academic outcomes as it is the most proximal and academic content instruction is coded under this dimension (Hamre, Hatfield, Pianta, & Jamil, 2014; Hindman & Morrison, 2012). There are other commonly used measures of classroom quality like the Early Childhood Environment Rating Scale (ECERS), however, even studies using the same measures suggest mixed results and generally weak relations between classroom quality and child academic readiness outcomes.

For example, Burchinal and colleagues (2011) conducted a meta-analysis and a coordinated secondary data analysis on the impact of classroom quality on academic school readiness and reported "quite modest" associations in both projects. Specifically, the meta-analysis reported on 97 associations between classroom quality and child outcomes, and partial correlations between these variables ranged from .05 to .17. Similarly, the secondary data analysis yielded average partial correlations between classroom quality and academic outcomes

of .06 for language outcomes and .03 for math and literacy. Further, Burchinal and colleagues (2014) found no relationship between higher classroom quality and language, literacy, or math readiness in rural, low-income preschoolers, although they did find that high-quality classrooms significantly reduced behavior problems. Interestingly, however, other work by this team (Burchinal, Vandergrift, Pianta, & Mashburn, 2010) suggests that the generally low quality of early care settings – particularly regarding cognitive stimulation – may attenuate relations between classroom quality and academic skills, and that effects more reliably emerge only when instructional quality is relatively high (i.e., above a threshold of at least moderate quality).

Recent results from citywide universal preschool experiments also offer mixed evidence for the relation between classroom quality (as measured by the CLASS) and academic school readiness and also complicate the quality threshold hypothesis. Johnson and colleagues (2016) reported that higher levels of instructional quality significantly predicted higher levels letter-word identification, spelling, and applied problem solving skills in the public preschool program in Tulsa, Oklahoma. However, Weiland and colleagues (2013) found no relationships between classroom quality and vocabulary outcomes in their citywide preschool intervention in Boston, even while finding effects of classroom quality on executive functions. Results from the Boston study were surprising because the research team made intensive efforts to improve instructional quality and were successful in doing so, given that instructional support scores among their teachers after the training were well above national averages (Weiland et al., 2013). They were also successful in boosting children's academic school readiness (Weiland & Yoshikawa, 2013). Given that their intervention improved both instructional quality and academic outcomes – but those two variables were not directly related – it may be the case that a third variable was

facilitating that relationship. This study examines approaches to learning as a possible third variable.

Approaches to Learning and Academic School Readiness

The evidence clearly and consistently shows that approaches to learning contributes to academic school readiness. For example, McWayne and colleagues (2004) demonstrated that approaches to learning predicted math and language skills at the end of the Head Start school year. Similarly, Bustamante and colleagues (2017) showed that approaches to learning predicted gains in science school readiness across the Head Start school year. Moreover, taking a longitudinal approach, Li-Grining and colleagues (2010) found that early approaches to learning predicted individual trajectories of reading and math performance across elementary school in a sample of over 10,000 children.

These associations likely emerge because being able to persist, sustain focus, collaborate with peers, and be open to new and challenging experiences helps children engage with and learn from the classroom curriculum. For example, Fantuzzo and colleagues (2011) demonstrated that an integrated curriculum with an intensive focus on approaches to learning significantly improved language and math outcomes in children served by Head Start, compared to the control group. Therefore, research that aims to capture the active ingredients that boost academic school readiness should account for approaches to learning.

Classroom Quality and Approaches to Learning

Approaches to learning is a malleable skill set; in fact, there is strong evidence that classroom quality (as measured by the CLASS) predicts approaches to learning (Domínguez, Vitiello, Fuccillo, Greenfield, & Bulotsky-Shearer, 2011; Domínguez, Vitiello, Maier, & Greenfield, 2010; Hu, Teo, Nie, & Wu, 2017). In other words, accounting for a variety of

relevant factors, children in higher quality early childhood classrooms build more competence in the area of approaches to learning than peers exposed to lower quality instruction.

All three dimensions of quality captured in the CLASS (i.e., emotional support, classroom organization, and instructional support) may independently support children's approaches to learning. Children in classrooms with high *emotional support* may feel more comfortable taking risks and trying new things. They might also embrace challenges and persist in the face of failure when their teachers are warm and positive, regardless of the outcome of their efforts. Children in classrooms with strong *classroom organization* may find it easier to collaborate, as they experience relatively less misbehavior, and conflicts are dealt with quickly and efficiently. Children may also be better able to hone their attentional skills when activities are well-paced with few disruptions. Finally, when teachers provide solid *instructional support,* children receive high-quality feedback that challenges their thinking. They also consider "why?" and "how?" questions through high-quality language interactions, which capture their interest and encourage their effective communication with teachers and peers. In sum, the relationship between classroom quality and approaches to learning is important because it may represent an additional pathway through which classroom quality is affecting academic school readiness.

Classroom Quality May Relate to Academic School Readiness through Approaches to Learning

One recent secondary data analysis of a nationally representative sample of children served by Head Start suggests that approaches to learning might play a key role in the relationship between classroom quality and academic school readiness. Meng (2015) showed that approaches to learning was a protective factor, buffering adverse effects of low classroom quality on early academic outcomes. Specifically, while low classroom quality was, in general,

detrimental to children's early literacy scores, children with high approaches to learning did not experience the negative effects of poor classroom quality on their early literacy. The author posited that children with high competence in approaches to learning were able to extract information about literacy from hard-to-follow or infrequent instruction, whereas peers with lower competence in approaches to learning had more difficulty accessing instruction. Approaches to learning, then, may act as a driver of focused learning, which would be particularly important in classrooms where content is not clearly delivered.

Further, a related but distinct domain general learning skills—executive functioning—has been demonstrated as a mediator between classroom quality and academic outcomes (Downer & Pianta, 2006; Graziano, Reavis, Keane, & Calkins, 2007; Raver, Jones, Li-Grinning, Zhai, Bub, & Pressler, 2011). While previous research demonstrating executive functioning as a mediator combined with the aforementioned study by Meng support the intriguing idea that approaches to learning may work with classroom quality to affect academic school readiness, more empirical evidence is necessary to substantiate this possibility. Our study employed rigorous structural equation modeling strategies to test for the presence of an indirect effect of teacher-rated approaches to learning between classroom quality and academic school readiness outcomes in a large, nationally representative sample of children served by Head Start. Such an effect would provide support for an intentional classroom focus on approaches to learning due to its ability to serve as a facilitator between high-quality teacher-child interactions and school success.

Current Study

This study examined two specific research aims. First, we examined the links between global classroom quality (all three domains of the CLASS), approaches to learning, and academic school readiness – specifically testing for an indirect effect of teacher-rated approaches

to learning between classroom quality and academic readiness -- net of the effects of a constellation of covariates. We hypothesized an indirect effect of classroom quality on academic school readiness through teacher-rated approaches to learning. Second, we explored the threshold hypothesis of instructional quality (the domain of the CLASS most related to academic school readiness) by dividing the sample into high vs. low instructional support to examine if relationships between instructional quality and school readiness outcomes differed in high vs. low classrooms. We hypothesized that, in classrooms with higher quality instructional support, instructional support would play a greater role in both academic school readiness and teacher-rated approaches to learning, when compared to low-support classrooms.

We note that, while formal mediation analyses would be ideal for addressing these questions, such an approach would require observations of classroom quality prior to collection of the outcome data (in order to temporally proceed the outcomes). The current study only includes classroom quality observations at the end of the school year, consequently, we employ structural equation models to examine indirect effects, a less precise but still informative strategy for understanding the paths of association among these constructs.

Method

Procedures

Data were drawn from the Family and Child Experiences Survey (2009), a large-scale, nationally representative study of children and families in their first year of Head Start (ACF, 2013). Participants in this cohort of the FACES study were selected from the total population of Head Start programs in the United States, and stratified into groups with approximately equal enrollments using key demographic variables (e.g., geographic region, metropolitan status, percent minority, auspice type, and percent of English language learners). Using probability-

proportional-to-size methods, particular programs were identified, individual centers within each program were selected, and classrooms in each center were randomly chosen. Thereafter, a fixed number of children were randomly selected and recruited. Approximately 90% of eligible children, families, and educators consented to participate. The FACES team constructed a series of weights that allows for the calculation of parameter estimates that represent the larger population of children who began their first year of Head Start in 2009; in other words, weights adjust estimates to be representative of the national population at that time. All direct child assessments and teacher rating scales used in this study were collected in the fall and spring of the 2009-2010 Head Start school year. Children were assessed one-on-one in a quiet area by a trained assessor.

Participants

A total of 2,145 preschoolers from 514 Head Start classrooms were included in this study. Children ranged from 32 to 59 months of age (M = 45.95, SD = 6.48). The sample was ethnically diverse; 40% of children were Hispanic/Latino, 33% were African American (non-Hispanic), 20% were white (non-Hispanic), and 7% were of other or multiple backgrounds. Additionally, 30% of children spoke a language other than English at home. Half of children (50%) were female. All families were at or near the poverty line; the average income-to-poverty ratio was 2.4 to 1. About a third of mothers did not complete high school (36%), more than half graduated from high school or vocational school (58%), and a small minority held a bachelor's degree (6%). Data were weighted to be nationally representative of children and families beginning Head Start in 2009 with the normalized PRA12OCW variable.

Measures

Child outcome data were collected in the fall and spring of the Head Start year. However, classroom quality observations were only collected in the spring; we note that this data collection schedule falls short of the temporal sequence that would support a formal mediation analysis.

Approaches to learning. Approaches to learning was rated by teachers in fall and spring of Head Start using the six items that comprise the approaches to learning scale from the ECLS-K study (U.S. Department of Education, 2002). For each item, teachers rated children on a scale of 0 (never) to 3 (very often) on their learning skills. Items tapped a range of constructs, including whether or not the child "pays attention well," "persists in completing tasks," or "shows eagerness to learning new things." The composite score is a mean of the items. This scale has been used with diverse populations, has established reliability ($\alpha = .89$), and has demonstrated relationships with academic achievement (Duncan et al., 2007).

Classroom quality. In spring, classroom quality was measured using the Classroom Assessment Scoring System (CLASS; Pianta et al., 2008). Classroom observations were conducted live and lasted approximately four hours. The CLASS measures teacher-child interactions and global quality across three domains: Emotional Support (including the subscales of positive climate, negative climate, teacher sensitivity, and regard for student perspective); Classroom Organization (including the subscales of behavior management, productivity, and instructional learning format); and Instructional Support (including the subscales of concept development, quality of feedback, and language modeling). Items are scored on a 7-point scale, with higher scores reflecting stronger quality. Internal consistency ranged from 0.79 (Instructional Support) to 0.91 (Emotional Support). Inter-rater reliability (coding within one point of master raters) averaged 87 percent. For this study, we averaged the scores from each of

the three domains to create one total classroom quality score, as suggested by Hamre and colleagues (2014).

Academic school readiness. Three standardized measures of academic skills were collected and the standardized scores were used for all three measures.

Mathematics. The applied problems subtest of the Woodcock Johnson III (Woodcock et al. 2001) was used to directly assess mathematics skills in fall and spring, and particularly problem solving including simple counting, addition, and subtraction. Items relied heavily on experimenters verbally explaining situations or scenarios, after which children computed a response. This norm-referenced assessment has strong published internal reliabilities (α = .79 to .90: West et al., 2010).

Literacy. The letter-word identification and spelling subtests from the Woodcock Johnson III (Woodcock et al. 2001) were used to directly assess literacy in fall and spring. In the letter-word identification subscale, children identified letters and then decoded increasingly complex words. In the spelling subtest, children performed prewriting and spelling skills such as drawing lines and tracing letters. Children also produced upper- and lowercase letters and spelled words. As above, published internal reliabilities are strong (α = .79 to .90: West et al., 2010).

Vocabulary. The Peabody Picture Vocabulary Test-4 (PPVT; Dunn et al., 2007) was used to directly assess receptive vocabulary in fall and spring. During the PPVT, children chose one image out of four to match the provided prompt. The PPVT is well-established with high reliability in standardization samples (Dunn et al., 2007), with internal consistency above 0.96 and test-retest reliability above 0.92. In the FACES 2009 study, internal reliability was high in the fall (0.97) and spring (0.95).

Demographics. Teacher and parent surveys were used to collect demographic information such as children's age, gender, race, income to poverty ratio, and mother's highest level of education.

Missing Data

The final, weighted sample of 2,145 participants included (by virtue of the weight) children who had complete data on classroom quality and demographic variables in the spring of 2010. The measures of approaches to learning had no missing data in the fall and 2% missing data in the spring, while missing data on academic school readiness ranged from 8 to 34% in the fall and 7 to 19% in the spring. Examination of missing data revealed that data were missing at random (i.e., missingness was not completely random, but rather was correlated with some variables in the dataset). For example, younger children, Latinos, and children whose mothers did not graduate from high school were more likely to have missing data on at least one of these key variables variable ($p < .05$ for all) and all of these variables were included as covariates in the model. However, it is possible that other, unobserved variables are correlated with missingness. Parameter estimates were adjusted for missing data using Full Information Maximum Likelihood (FIML) estimation in Mplus 7.0 (Hancock & Mueller, 2006). FIML uses all available data for each case when estimating parameters.

Results

Descriptives

Descriptive statistics are presented in Table 1. In fall, children scored an average of 1.62 (SD = 0.69) out of a possible 3.00 in approaches to learning, while spring scores averaged 1.87 (SD = 0.73). Thus, no floor or ceiling effects emerged, and the data suggest that children used most of these strategies at least some of the time. A paired sample *t*-test demonstrated that, on

average, children made significant gains in approaches to learning from fall to spring (t (2097) = 17.30, $p < .01$). To examine the data for potential outliers we reviewed scatter plots of approaches to learning, academic readiness, and classroom quality outcomes in the whole sample and in the subgroups above and below the mean of Instructional Support. From these scatter plots we determined that no outliers are placing undue influence on the sample or any sub-group of participants.

Research Aim 1

Analytic Plan. All inferential analyses were conducted in a structural equation modeling (SEM) framework to allow for the construction of latent variables and the modeling of a number of paths among variables of interest and covariates. Notably, while approaches to learning might theoretically fully or partly mediate the relation between classroom quality and academic outcomes, the cross-sectional nature of the spring data collection points makes a test of formal mediation less appropriate (Maxwell, Cole, & Mitchell, 2011); hence, we instead study the related but distinct possibility of an indirect association using a structural equation model spanning both the fall and spring time points.

Children were nested within classrooms, with approximately four study-enrolled children per classroom. Further, intra-class correlations ranged from .4 to > .9 suggesting that certain measures (particularly teacher report) had substantial variability at the classroom level, thus, we utilized the "CLUSTER" command in Mplus to adjust the standard errors at the classroom level in order to control for the nested nature of the data. To determine model fit, the Bentler Comparative Fit Index (CFI) was examined, based on the criterion that values > 0.95 were considered acceptable fit (Bentler, 1990). The Standardized Root Mean Square Residual (SRMR) was examined, with values below 0.08 considered acceptable model fit (Hu & Bentler,

1999). Finally, the Root Mean Square Error of Approximation (RMSEA) was also examined, with values below 0.06 considered adequate model fit (Browne & Cudeck, 1992). We did not focus on chi-square as a metric of fit, given its sensitivity to sample size (Kline, 2011).

Preliminary correlations. Correlations between all study variables are presented in Table 2. Overall, correlations show that approaches to learning had small to moderate correlations with academic school readiness (r = .12 to .24, p < .001), and academic school readiness outcomes were moderately correlated with one another (r = .27 to .48, p < .001). Classroom quality showed small correlations with approaches to learning (r = .06 in the fall and .11 in the spring, p < .05), and almost no correlation with academic school readiness outcomes (r = -.01 to .04, p > .05).

Measurement model. Given the study aims and the positive correlations between academic readiness outcomes, we constructed one latent *academic outcomes* variable for the fall and another for the spring to provide clearer and more parsimonious findings. Exploratory factor analyses, using principal axis factoring and the default (oblique) Geomin rotation in Mplus, were used to create both latent variables. For inclusion in the latent variable, indicators (i.e., the four academic measures) had to load on their respective latent construct with a loading of at least 0.40 (Cromrey & Lee, 1992). Exploratory factor analyses yielded a single latent variable for academic school readiness in the fall, and another single latent factor for academic school readiness in spring. At both time points, indicator loadings ranged from 0.558 to 0.793 and were statistically significant (p <.001 for all). The measurement model met criteria for all three indices of model fit (RMSEA = .033; CFI = .985; SRMR = .030).

Structural model. Complete results of the model are presented in Table 3. The covariates for the following models were selected due to their proximity to children's readiness outcomes and frequent employment in studies utilizing the FACES 2009 dataset (Ansari, Purtell, &

Gershoff, 2016; Hindman, Skibbe, Miller, & Zimmerman, 2010). Of greatest interest, classroom quality significantly predicted gains across the Head Start year in teacher-rated approaches to learning (i.e., predicting spring score, controlling for fall), accounting for children's race, age, gender, income to poverty ratio, and maternal education ($\beta = 0.151$, $p = .040$). At the same time, gains in teacher-rated approaches to learning predicted gains in academic school readiness, controlling for the same covariates ($\beta = 0.105$, $p < .001$). Classroom quality did not directly predict gains in academic school readiness ($\beta = -0.009$, $p = .844$). However, there was a significant indirect effect of classroom quality on academic school readiness through approaches to learning ($\beta = 0.016$, $p = .049$). Model fit met criteria for two of three indices and only fell slightly short of the expected .95 value on CFI (RMSEA = .050; CFI = .932; SRMR = .049), thus this model was retained as having adequate model fit. The final structural model is presented in Figure 1.

Research Aim 2

In light of the threshold hypothesis advanced by Burchinal and colleagues (2010), we, explored whether direct effects of classroom quality on academic outcomes might emerge in classrooms where Instructional Support (the domain of the CLASS most related to academic outcomes) was highest. To this end, we replaced the CLASS total with the total of Instructional Support only (see Figure 2). Next, we split the sample into two groups: those for whom classroom Instructional Support scores were above the sample mean (M = 2.25, SD = .65) and those for whom Instructional Support was at or below the mean (N = 903 for the high Instructional Support sample and N = 1,242 for low Instructional Support sample). We then re-ran the model used for Research Aim 2 in each portion of the sample to determine whether the pattern of associations between classroom quality and child academic outcomes might differ

across these two sub-samples, and whether the link between teacher-rated approaches to learning and academic skills might change as well. As an additional sensitivity test we also split the sample by the median value of 2.21 and the model fit and pattern of results remained comparable.

High Instructional Support. This model had comparable model fit to the original model (RMSEA = .056; CFI = .924; SRMR = .048), and, as with the whole sample, once again Instructional Support was not a significant predictor of gains in academic school readiness, even though children were in classrooms with above average instructional support ($\beta = 0.033$, $p = .702$).

Low Instructional Support. Once again the model had comparable fit to the original model (RMSEA = .054; CFI = .916; SRMR = .054). For children in classrooms scoring below the mean on Instructional Support, Instructional Support was a significant predictor of gains in school readiness outcomes across the Head Start School year ($\beta = 0.219$, $p = .048$), holding constant everything else in the model (see Figure 2).

Discussion

This study used the nationally representative FACES 2009 data set to examine the role that teacher-rated approaches to learning plays in the relationship between classroom quality and academic school readiness in children served by Head Start. Our model demonstrated an indirect effect between classroom quality and academic school readiness through approaches to learning. Additional models also suggest that the Instructional Support domain of the CLASS is a significant predictor of gains in academic school readiness (i.e., predicting spring score, controlling for fall) – however, contrary to hypotheses -- only for children in classrooms with

below average Instructional Support. Although associations were generally small, these results contribute to the literature in several important ways.

Descriptives

Results provide a nationally representative look at teacher-rated approaches to learning skills in children served by Head Start. Given that approaches to learning is a powerful, domain-general skill that positively relates to academic school readiness, it is encouraging that, on average, children were scoring in the upper half of the distribution in the fall and spring while making significant gains in approaches to learning across the Head Start school year. However, a substantial subset of children were rated a one or lower (scores ranged from zero to three) in the fall (25.7%) and the spring (18.3%), meaning that a large minority of this population demonstrates very low approaches to learning. These children should be the focus of targeted interventions on approaches to learning to enhance their ability to engage with and benefit from classroom instruction. Conversely, a smaller subset of children were rated at the highest possible score on approaches to learning in fall (5.3%) and spring (11.9%). Thus, the measure used in this dataset was not able to capture growth in this small subset of children. Future examinations of approaches to learning should utilize measures that are better able to discriminate between children on the higher end of the distribution (possibly by adding more items).

Classroom Quality and Academic Outcomes

Results contribute to the mixed literature on the relationship between classroom quality and academic school readiness outcomes. Research demonstrates inconsistent relationships between indicators of classroom quality and academic school readiness (Burchinal et al., 2014; Weiland et al., 2013; Zaslow et al., 2010). Our model fits this narrative, in that classroom quality did not directly predict academic school readiness. However, quality still had an indirect effect

on academic readiness through approaches to learning. This suggests that quality instruction should still be a focus of professional development for preschool teachers, as even in the cases where it is not directly predicting language and math skills, it still affects other domain-general skills that promote learning in those areas (Weiland et al., 2013). Additionally, intervention efforts that target classroom quality would be wise to consider approaches to learning as a possible lever to boost academic outcomes.

Research Aim 1

Results also support recent findings that approaches to learning plays a key role in the relationship between classroom quality and academic outcomes in Head Start (Meng, 2015). As detailed above, formal mediation analyses were not possible given the single time point of classroom quality observations at the end of the school year. However, the two, repeated measures of approaches to learning and academic skills, as well as the array of available educator, child, and family covariates enhance the rigor of this work. Overall, our findings suggest that high-quality teacher-child interactions are related to increased gains in teacher-rated approaches to learning across the Head Start school year. In turn, approaches to learning skills like persistence, sustained focus, peer communication and collaboration, and openness to new and challenging experiences relate to children more effectively navigating the early childhood classroom and learning more academic content across the year. This is important, given the increased pressure on preschool programs to boost performance on language and math assessments. Indeed, these outcomes are often tied to district or state funding decisions and results from this study suggest approaches to learning may be a critical lever towards building those skills.

Research Aim 2

Another important contribution of this study is the further examination of the relation between Instructional Support and gains in academic school readiness. Overall, Instructional Support was not predictive of children's gains in academic readiness. However, contrary to this studies hypothesis, the Instructional Support domain of the CLASS positively predicted gains in academic school readiness in classrooms with below average Instructional Support. This finding suggests that, on average, Instructional Support at the high end of the low range (slightly above two out of seven), does not have a substantially different impact on children's academic learning than Instructional Support at high end of the spectrum (between three and four out of seven). Conversely, Instructional Support at the high end of the low range predicts increased child learning when compared to the very lowest Instructional Support scores (approx. one out of seven). Although this result is contrary to previous research examining thresholds of quality (e.g., Burchinal et al., 2010) it may be the case that the level of Instructional Support in this sample was not high enough to demonstrate a significant advantage for the highest performers over the moderate to low performers. However, demonstrating some level of Instructional Support even if on the low end, seems to represent an appreciable difference for children's academic outcomes in comparison to classrooms providing little to no Instructional Support. The implications of this finding become even greater when considering Instructional Support is consistently the lowest scoring domain of the CLASS; in fact, one-third of the teachers in this nationally representative sample of Head Start classrooms scored below a two out of seven (Malone et al., 2013). Administrators and interventionists should take note of this finding as targeted efforts to improve Instructional Support for teachers at the very bottom of the distribution could have substantial impacts on children's academic school readiness.

Implications

As preschools wrestle with increasing demands on children for kindergarten readiness, less effective but more structured approaches such as rote learning and memorization may present some appeal. However, these results suggest that fostering approaches to learning could have meaningful benefits for children's learning, in conjunction with high-quality classroom practices. Thus, early childhood educators should aim to place children in situations that foster approaches to learning and provide opportunities for high-quality teacher child interactions. Challenging and cognitively stimulating tasks like puzzles and mazes might allow children to exercise persistence and acclimate to engaging in difficult situations, and collaborative groups games provide children the opportunity to navigate peer interactions and work towards a common goal—all aspects of approaches to learning.

Further, recent research suggests that early childhood science has a unique bidirectional relationship with approaches to learning (Bustamante, et al., 2018). During hands-on science learning experiences children engage in *strategic planning* to develop and test hypotheses, they have to remain *motivated* and *persistent* as they revise and retest hypotheses, and science experiences are often conducted in *small groups*. *Strategic planning, motivation, persistence,* and *group learning* are all key indicators of approaches to learning suggesting science may be an ideal context to foster these skills (Bustamante, Greenfield, & Nayfeld, 2018). Further, on average, Instructional Support scores on the CLASS are higher during science activities than other content domains (e.g., math, language, literacy; Cabell et al., 2013; Fuccillo, 2011). This is likely because "why" and "how" questions—key to the Concept Development subscale of Instructional Support—arise naturally when children and teachers are working together to understand scientific phenomena, and rich vocabulary words—key to the Language Modeling indicator of Instructional Support—are often required to explain these phenomena.

Lastly, evidence suggests that early science also fosters children's math and language learning (Greenfield, 2015; Morgan et al., 2016). Therefore, early childhood science may offer uniquely powerful returns, in terms of child outcomes, providing a central context that captures children's attention, connects learning across domains, and promotes domain general learning skills (Bustamante, Greenfield, & Nayfeld, 2018). This context is important as fostering approaches to learning is difficult devoid of academic content, thus, initiatives like Fantuzzo and colleagues' (2011) EPIC curriculum, that successfully intervened on children's approaches learning by focusing explicitly on approaches to learning skills within contextualized and engaging content should be a greater emphasis of the field.

Limitations and Future Directions

Although this study provides a large-scale, nationally representative look at the role of teacher-rated approaches to learning in promoting academic readiness, there are limitations inherent to secondary data analyses that must be addressed. Secondary data sets provide rich information on many children; however, the nature of the data collected can limit the questions that can be addressed. One key issue in the current data is the need for a richer assessment of approaches to learning. In the current study, teachers reflected on children's skills using six items. Although this was a highly feasible approach, providing reliable and individualized information about children while allowing teachers ample opportunity to complete other measures and conduct their normal workday, the relatively few items on the scale may reduce variability and mask additional relationships that would appear with a more in depth measure of approaches to learning. A more comprehensive measure of approaches to learning that is valid and reliable in children served by Head Start is the Learning-to-Learn Scale (LTLS; McDermott et al., 2011). Future research should investigate the relationships between classroom quality,

approaches to learning, and academic school readiness using the LTLS or another in depth measure of approaches to learning.

Second, the timing of the data collection can limit the questions that can be addressed. For example, because the CLASS observations were conducted at the end of the school year, along with the second assessment of approaches to learning, we were not able to formally test for mediation. Mediation requires a temporal sequence to ensure the directionality of the paths (Maxwell, Cole, & Mitchell, 2011). While the indirect effect demonstrated by our model does provide useful evidence, future research should formally test the degree to which approaches to learning partially or fully mediates the relationship between classroom quality and academic school readiness.

Third, these data are correlational in nature; in fact, it is worth noting that a model with all of the same paths, but oriented in the opposite direction, would reveal the same fit. Although analyses included a host of covariates, there is still potential that omitted third-variable biological and environmental factors, particularly of a time-varying nature, might contribute to the observed relations. Further, these data report on Head Start as implemented across the nation, rather than on an intentional and carefully planned intervention. Future research should test how well classroom quality interventions can improve approaches to learning and to what extent those improvements in turn predict children's academic outcomes.

Conclusion

This study makes an important, albeit correlational, contribution to the literature by highlighting approaches to learning as a third variable that may facilitate gains in academic school readiness in high-quality classrooms. In a preschool climate where "soft skills" like approaches to learning are often overlooked in favor of rote academic instruction, our study

provides evidence that these skills may be critical levers for academic success. Further, our findings highlight the need for providing support to early educators around instructional quality, particularly for teachers receiving the lowest scores on the instructional support domain of the CLASS. Results from this study suggest that even a small improvement in instructional support among the lowest performing teachers can make a meaningful difference in children's academic outcomes. In today's world, where endless facts are at our fingertips, children need adaptive learning skills to come up with creative solutions to ever-changing problems. Of course, basic math and literacy skills are critical for school success, but approaches to learning equip children with the tools to learn in any content domain. In the eternal effort to boost test scores, we must not lose sight of the importance of other skills that children need to become well-rounded, productive members of the 21st century.

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