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CHILD DEVELOPMENT

EMPIRICAL REPORT

# The association between and development of school enjoyment and general knowledge

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**Abstract**

Learning environments can support the development of foundational knowledge and promote children's attitudes toward learning and school. This study explores the relation between school enjoyment and general knowledge from preschool (2016–2017) to kindergarten (2017–2018) in 1359 children ($M_{age}$ = 55, 61 months, female = 50%; 58.5% Hispanic, 17% Black, 10% Asian, 10% White, 5% multiracial/other; linguistically diverse). Cross-lagged panel models showed significant bidirectional associations between preschool enjoyment and change in general knowledge from preschool to kindergarten with a standardized coefficient of $\beta = .21$ ($p < .001$) and associations between preschool general knowledge and change in enjoyment, $\beta = .09$ ($p = .015$). Exploratory analyses with teacher characteristics and demographic subgroup comparisons are discussed. These associations suggest the potential intervention strategy of promoting early school enjoyment to support broader academic development.

Early education provides an important, lasting foundation for future learning both in the skills and knowledge developed and in the development of attitudes and approaches to learning (NICHD Early Child Care Research Network, 2002). Foundational knowledge, such as children's general knowledge and understanding of the world, and their curiosity to learn, develop from early learning experiences (Gottfried et al., 2016), and the learning environment influences children's development of academic skills (Burchinal et al., 2011). Early educational environments are becoming more academically focused and less play-based (Bassok et al., 2016) despite the benefits of playful learning in early childhood (e.g., Hirsh-Pasek et al., 2009; Lillard et al., 2013; Zosh et al., 2018). One benefit of playful learning is that it is enjoyable (Zosh et al., 2018). Enjoyment of learning and school is related to students' curiosity and love of learning in both teacher-led and individual tasks (Wagner et al., 2020) and is associated with positive educational outcomes (Morris et al., 2021; Shah et al., 2018). Thus, understanding early influences on school enjoyment and readiness and how they develop is important (Stipek & Greene, 2001). Attitudes toward school are important for kindergarten adjustment but are infrequently studied (Daniels, 2014). We expand prior work by studying school enjoyment and general knowledge, including social studies and science, which aligns with children's curiosity about and desire to understand the world and other people. Specifically, this study explores the relationship between general knowledge and school enjoyment from preschool to kindergarten.

## School enjoyment

School enjoyment is a type of positive effect related to interest, curiosity, and learning (Ainley & Hidi, 2014; Lamnina & Chase, 2019; Litman & Spielberger, 2003; Pekrun et al., 2011), and is defined as positive feelings about participation in school (Ainley & Hidi, 2014). We

**Abbreviations:** K, Kindergarten; PK, Pre-kindergarten; SEM, Structural Equation Modeling.

focus on school enjoyment in young children because it is a somewhat concrete concept (Borgers et al., 2004; Hoppe et al., 1995), while the meanings of related constructs such as curiosity are abstract even for teachers (e.g., Spektor-Levy et al., 2013). Consistent with the Broaden and Build theory (Fredrickson, 1998), positive affect for learning, such as school enjoyment, can lead to an "upward spiral" of broadened cognition that further supports future positive affect (Fredrickson & Joiner, 2002). Fortunately, young children begin school with high levels of enjoyment toward school (Howse et al., 2003; Nurmi & Aunola, 2005).

Attending high-quality preschool prepares children for formal education, especially children most likely to begin school behind their peers (Phillips et al., 2017). Evidence suggests that school enjoyment can support children's successful transition to kindergarten (Daniels, 2014). In a recent study using a three-item scale to measure preschool children's school enjoyment (Lichtenfeld et al., 2012; Ruzek et al., 2020), school enjoyment related to other important motivational factors and learning orientations, including growth mindset, perceived academic competence, peer social skills, and task orientation (Ruzek et al., 2020). These associations provide potential explanations for the observed link between school enjoyment and achievement (e.g., Morris et al., 2021), discussed further below. Importantly, enjoyment is associated with academic achievement across populations (Ainley & Ainley, 2011), with a universal relation observed in all 68 PISA participating countries (Loderer et al., 2020). Further, across different backgrounds, psychometric testing of measures of enjoyment shows similar factor structure and conceptualization (Loderer et al., 2020). Despite measurement invariance cross-culturally, school enjoyment itself might be influenced by student characteristics, instructional characteristics, and student–teacher relationships (Gorard & See, 2011). Broader culture may also influence the intensity of and associations between enjoyment and achievement (Li et al., 2021). Although enjoyment might be influenced by a broad range of factors (Frenzel et al., 2007), this study focuses on the association between preschool and kindergarten school enjoyment and general knowledge in a diverse sample of low-income younger children, focusing on the bidirectional associations between school enjoyment and general knowledge, with some exploratory analysis of teacher and child characteristics.

## School readiness and general knowledge

Early academic knowledge is a consistent, strong predictor of later academic success: it strongly predicts math skills, as well as reading and attention (Duncan et al., 2007). Opportunities to learn general knowledge, which includes humanities, social studies, and science, occur much less frequently than math and literacy instruction in early education (Bassok et al., 2016) despite findings that knowledge about the world can support reading comprehension and even math performance (Grissmer et al., 2010; Hirsch et al., 2002; O'Reilly et al., 2019). Further, the benefits of preschool on children's kindergarten general knowledge appear to be more persistent (i.e., continue to show stronger associations) than in more discrete domains like literacy (Ansari et al., 2020). Although general knowledge has long been argued to be essential to support broader learning across domains (Hirsch et al., 1988), it has not been a prominent topic of early education research. One exception is a study that showed that general knowledge was a strong predictor of later math learning over the variance explained by initial math ability, and an even stronger predictor of later literacy than early literacy ability, with general knowledge also associated with later science learning (Grissmer et al., 2010). This same study reported evidence that children academically at risk for lower achievement show the largest deficit in general knowledge in cross-domain comparisons. Because general knowledge is associated with learning across domains, it could provide a type of supporting foundation of knowledge for future learning (e.g., Cabell & Hwang, 2020), yet there is a dearth of research about it in the school readiness literature. Thus, general knowledge may have the potential to support broader learning and it is important to study to understand its development.

## Relation between school readiness and school enjoyment

Research indicates that students' learning-related beliefs and feelings develop early and are important for academic performance (Stipek & Ryan, 1997). For example, school enjoyment at age 6 is associated with cross-discipline achievement 10 years later (Morris et al., 2021). School enjoyment is related to the affective components of curiosity, including "liking" or "enjoying" trying new things, which are associated with school readiness and learning (Lamnina & Chase, 2019; Litman, 2008; Shah et al., 2018), perhaps through promoting curiosity and higher engagement in more meaningful learning experiences, such as using constructive cognitive practices like making connections to material (both personal connections and across topics) or identifying gaps in one's knowledge and asking related questions (Chi & Wylie, 2014; Jirout, 2020; Jirout et al., 2018). More generally, Sidi et al. (2018) found that positive affect was associated with better cognitive processing. Further, positive feelings for learning and school are related to a more general valuing of learning (Lazarus & Smith, 1988). Thus, school enjoyment could have reciprocal bidirectional positive relations with learning similar to those observed for

curiosity (Wade & Kidd, 2019). Several studies have explored these relations specifically measuring enjoyment or more generally exploring enjoyment-related motivation (e.g., intrinsic motivation measured as liking learning).

Viljaranta et al. (2009) explored the direction of associations between feelings of enjoyment for math and literacy specifically with achievement. The relation between enjoyment and achievement was bidirectional, but only for math; the relation between literacy motivation and literacy achievement was not significant, even when assessed at the same time point (Viljaranta et al., 2009). Using binary levels of motivation (i.e., low, high), Nurmi and Aunola (2005) found that math and reading achievement did not predict a change from one level of motivation to another over time. The researchers found that being in the "low-motivation" group was associated with future lower achievement in math, although only between some time points. In a study of children from age 9 to 17, Gottfried et al. (2007) observed declines in both math achievement and math motivation, with early achievement directly relating to later achievement, but early motivation only indirectly related to later motivation through its relation to achievement. In other words, evidence suggested that the decline in achievement contributed to the decline in enjoying math, but not the opposite pattern (Gottfried et al., 2007). Bidirectional associations between motivation and achievement were found for younger children, although the association of achievement with later motivation was observed to be more consistent (Gottfried, 1990). Similarly, Aunola et al. (2006) showed bidirectional and reciprocal associations between math motivation and performance in children from preschool through second grade.

Prior studies have not looked at general knowledge and school enjoyment, although there are several reasons to expect an association between them. First, general knowledge involves social and natural science learning, which are academic topics that children across ages are most curious about (Post & Walma van der Molen, 2018), and, thus, might lead to higher enjoyment for learning. Second, general knowledge involves developing a broader understanding across domains through the exploration of ideas and spaces, which is more aligned with the ways that young children approach and learn about their world (Gopnik, 2012). Third, general knowledge seems to support learning across other domains, including math and literacy, and so prior observed relations between different domains and enjoyment are likely to generalize (Grissmer et al., 2010). In addition, school enjoyment likely promotes greater learning for general knowledge by providing more motivation for learning and more effective cognitive engagement (Jirout, 2020), as well as more creative, flexible thinking (Fredrickson & Joiner, 2002). For these reasons, and to address the lack of research on the development of general knowledge, we were interested in exploring the relations between school enjoyment and general knowledge specifically.

## Current study

The current study tested whether preschool enjoyment and general knowledge were respectively associated with kindergarten enjoyment and general knowledge, adjusting for preschool levels of each variable and other student background characteristics. We designed our study to test the hypothesis that school enjoyment and general knowledge at both preschool and kindergarten would significantly correlate. Because little research has been conducted on general knowledge, and there are inconsistencies between the direction of the relations between school enjoyment and other academic domains, we did not state specific hypotheses about the direction of the relation we were testing. Thus, although the analyses conducted were planned a priori, they were considered exploratory.

# METHODS

## Participants

Participants were children in preschool ($M_{age}$ = 55 months, SD = 3.5; $N$ = 1384; 50% female), who were followed into kindergarten ($M_{age}$ = 61 months, SD = 3.5; $N$ = 1348; 50% female) and have continued participation in a larger longitudinal study with unrelated research questions. Participation took place in publicly-funded preschools (2016–2017) and kindergartens (2017–2018) in a large mid-Atlantic U.S. school district. Participants in the publicly-funded preschool were classified as economically disadvantaged (200% of the federal poverty level), and by kindergarten, 83% of these students were eligible for free lunch with 14% eligible for reduced fee lunch. Students came from a diverse range of racial-ethnic backgrounds (58.5% Hispanic, 17% Black, 10% Asian, 10% White, 3% multiracial, and 2% another background). Approximately 21% of students spoke English at home, 55% spoke Spanish, and 24% spoke a different language. The sample selected for this study was of convenience, as the data analyzed were from an ongoing longitudinal study (see Supporting Information for additional information).

## Materials and procedures

Participation took place in children's schools where they were individually assessed by a trained data collector. This study received approval from the Institutional Review Board at the University of Virginia (IRB-SBS #2355: "FP3: Fairfax Pre-K to Third Grade Project") and all participants had informed parental consent (see Supporting Information for more information).

*General knowledge*

During the individual session, children completed the Woodcock-Johnson III General Knowledge subtest, sections A (Science) and B (Social Studies). Each section contained 28 items with a median reliability of .88 in the age 5 to 19 range. Scores were computed using the Woodcock-Johnson III scoring calculator. In this analysis, we used the W scores, which are appropriate for estimating change over time because they provide a continuous, equal-interval scale (see the Supporting Information for more information).

*School enjoyment*

Children were given a verbal survey based on prior work by Ruzek et al. (2020) including a scale based on the Achievement Emotions Questionnaire—Elementary Students class-related enjoyment scale, originally validated in second- and third-grade German and American samples focused on mathematics (Lichtenfeld et al., 2012). A recent study demonstrated psychometric support for school enjoyment as an independent learning orientation that can be reliably measured in preschool-age children based on factor analysis, expected convergent associations, and demonstrated invariance and reliability ($\omega$ = .78; Ruzek et al., 2020; see Supporting Information). This scale included three items (Enjoy1—Is school fun? Enjoy2—Are you excited to go to school? Enjoy3—Do you enjoy school?). Children responded by pointing to a graphical scale with three sizes of circles, with the smallest indicating "a little bit", the medium, "some," and the largest, "a lot."

We established scalar longitudinal measurement invariance, with a non-significant test (compared to the configural invariance model) showing no strong evidence that the engagement construct is being measured differently across the two time points, indicating that the construct was measured similarly over time and that changes observed are true construct changes and not due to measurement artifacts (see Supporting Information for detailed methods). A comparison of the latent means at the two times showed kindergarten students' enjoyment scores, on average, were .09 points lower than at preschool (note that the latent variables have mean 0, standard deviation 1). The 95% confidence interval of this difference was (−.19, .01), suggesting that kindergarten students are likely to report lower average school engagement than preschool students ($p$ = .08).

## Analytical model

A two-time point cross-lagged panel model focused on the two constructs of interest—general knowledge and school enjoyment—was used in this study (Rogosa, 1980; see Figure 1). This model estimates the association between the prior measurement of each construct at time $t-1$ and the other construct at time $t$ (cross-lagged paths) while simultaneously accounting for the stability of relations within the constructs over time (autoregressive paths). The relative strengths of the standardized cross-lagged paths are compared in these models to determine which variable has a stronger influence on the other (Hamaker et al., 2015). We treated the enjoyment construct as a latent variable measured by the three ordinal-scaled indicators with the factor loadings and item thresholds constrained to be equal at each time point (scalar invariance), providing an error-free measurement of enjoyment. Our model adjusted for child and family characteristics at preschool, including the child's sex, age, and whether they receive reduced-price or free

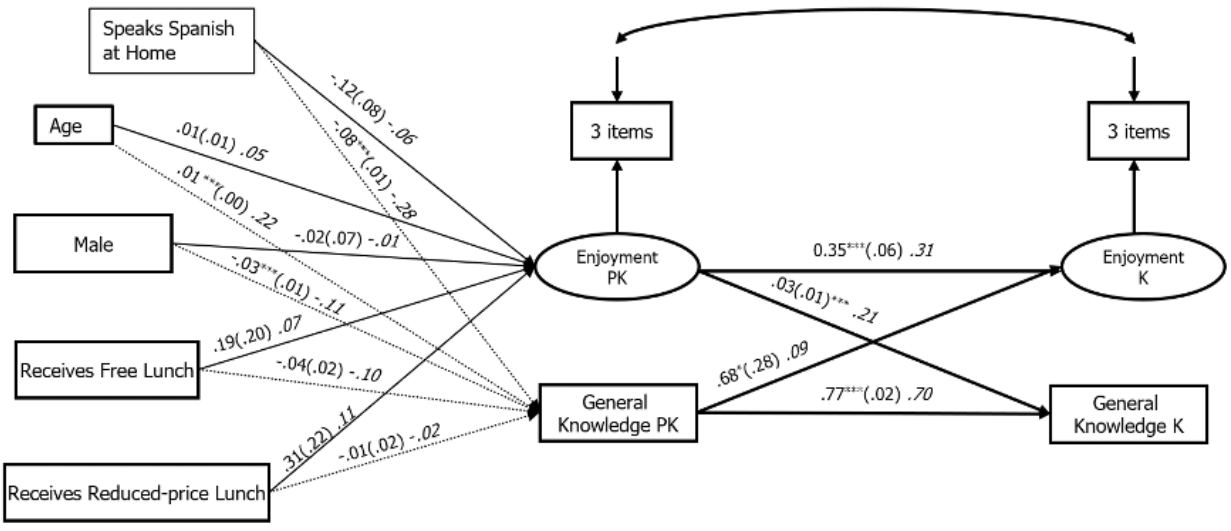


**FIGURE 1** Cross-lagged panel model results. Path coefficients–unstandardized estimate (standard error) standardized estimate. $N$ = 1384. Model fit: $\chi^2$(df) = 149.84 (51), root mean square error of approximation = .04, comparative fit index = .96, Tucker–Lewis index = .95, standardized root mean square residual = .08. *$p$<.05, ***$p$<.001

lunch as well as whether their family spoke Spanish at home (relative to English or another non-Spanish language). Adjusting for these covariates at the preschool time point allows their associations with a child's scores at kindergarten to be indirect and assumes that covariate associations linger over time (Little, 2013; results did not differ when adjusting for covariates at both preschool and kindergarten, see the Table S1). Standard errors were computed using the Huber-White sandwich estimator to account for the nesting of children within kindergarten classrooms.

Missing data ranged from 0% to 19% depending on the variable, leading us to multiply and impute 40 datasets using an unrestricted ($H1$) variance-covariance model in Mplus (Asparouhov & Muthen, 2010). Analyses were carried out on the multiply imputed data in Mplus 8.5 (Muthen & Muthen, 2018) using the weighted least squares means and variances estimator, which is appropriate for structural equation models (SEM) with large sample sizes (Nussbeck et al., 2006).

## RESULTS

Table 1 shows the means, standard deviations and the relevant polychoric, polyserial, and Pearson correlation coefficients among the study variables. The enjoyment items measured at preschool were significantly correlated with general knowledge at both preschool and kindergarten. In contrast, preschool general knowledge only significantly correlated with one of the kindergarten enjoyment items. General knowledge scores increased, on average, from preschool to kindergarten ($M_{\text{preschool}} = 440$, SD = 14 to $M_{\text{kindergarten}} = 451$, SD = 16) and were strongly positively correlated ($r = .69$).

Results from the cross-lagged panel model estimated from multiplied imputed data are shown in Figure 1. The autoregressive paths (directed arrows from a construct at preschool to the same construct at kindergarten) indicate the stability of the rank order of students from preschool to kindergarten. Focusing on the standardized autoregressive coefficients, the rank order of students was much more stable for general knowledge than it was for enjoyment ($b$s = .70 and .31, respectively). Of most interest are the cross-lagged paths (directed arrows from a construct at preschool to the other construct at kindergarten), which indicate the extent to which one construct predicts change in the other construct while simultaneously adjusting for the prior score on the predicted construct (i.e., the autoregressive path). The standardized cross-lagged coefficients are compared in these models to determine "causal predominance," (Hamaker et al., 2015) although the causality is at best, Granger causality (Granger, 1969) because of preschool predating kindergarten (temporal precedence) and not true causality due to random assignment to treatment and control groups (it would be impossible to randomly assign students to levels of enjoyment or general knowledge). In this case, the cross-lagged path from preschool enjoyment to kindergarten general knowledge is twice the size of the cross-lagged path from preschool general knowledge to kindergarten enjoyment ($b$s = .21 and .09, respectively). This model fits the data well, meeting or exceeding commonly-cited thresholds for excellent model fit in SEM literature (Hu & Bentler, 1999).

Post-hoc exploratory analyses adjusted for teacher factors and compared models estimated separately for (a) boys and girls and (b) Spanish-speaking and non-Spanish-speaking children. Adjusting for teacher factors

**TABLE 1** Correlations and descriptive statistics

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Enjoy1-PreK | 1 | | | | | | | | | | | | |
| 2. Enjoy2-PreK | **.56** | 1 | | | | | | | | | | | |
| 3. Enjoy3-PreK | **.44** | **.56** | 1 | | | | | | | | | | |
| 4. Enjoy1-K | **.17** | **.18** | **.17** | 1 | | | | | | | | | |
| 5. Enjoy2-K | **.21** | **.22** | **.18** | **.63** | 1 | | | | | | | | |
| 6. Enjoy3-K | **.11** | **.13** | .08 | **.55** | **.56** | 1 | | | | | | | |
| 7. GenK-PreK | **.12** | **.10** | **.19** | .04 | .05 | **0.08** | 1 | | | | | | |
| 8. GenK-K | **.12** | **.13** | **.23** | **.09** | **.10** | **.15** | **.69** | 1 | | | | | |
| 9. Male | **.10** | −.02 | −.01 | −.12 | −.03 | −.08 | **−.12** | **−.12** | 1 | | | | |
| 10. Age | .04 | .05 | .00 | .03 | −.02 | .00 | **.21** | **.15** | −.01 | 1 | | | |
| 11. Free lunch | .00 | −.01 | .02 | −.01 | −.02 | −.09 | **−.15** | **−.20** | .06 | .03 | 1 | | |
| 12. Reduced-fee lunch | .04 | .06 | .01 | .08 | .01 | .09 | **.11** | **.14** | −.05 | −.05 | NA | 1 | |
| 13. Spanish language at home | −.06 | −.01 | **−.13** | **.09** | .01 | −.01 | **−.36** | **−.33** | .03 | .00 | **.23** | **−.14** | 1 |
| Mean (SD) | NA | NA | NA | NA | NA | NA | 439.63 (14) | 450.90 (16) | 50% | 55 (3.5) | 83% | 14% | 55% |

*Note*: $N = 1186$. Bolded correlations are significantly different from 0 at $p < .05$. Except for age and general knowledge (GenK), all variables are categorical, and correlations among these variables were polychoric or polyserial (when involved with age or GenK).

did not alter the key associations and were not significant except for a positive association between kindergarten teachers having majored in early childhood education and kindergarten general knowledge. Observed associations were similar to those in the original model (Figure 1) for subgroups with the exception that the General Knowledge at PreK to Enjoyment at K path was non-significant for boys and non-Spanish-speaking children (see Tables S2 and S3).

## DISCUSSION

Preschool provides important educational experiences that can determine the starting point for students' academic trajectories (Ansari et al., 2021), including early attitudes about school and learning that are associated with later academic outcomes (Aunola et al., 2006; Morris et al., 2021). Research indicates the importance of both enjoyment and general knowledge for school readiness and learning (Grissmer et al., 2010; Shah et al., 2018). We extend prior work by exploring the developmental patterns in these constructs over time, further exploring bidirectional associations between school enjoyment and learning by using cross-lagged panel models, with specific methodological strengths of including a large and diverse sample, as well as studying a developmental period that is critically important for academic learning and a domain that is understudied in past research.

Results from the current study show bidirectional associations between general knowledge and enjoyment. Preschool general knowledge was associated with kindergarten enjoyment, adjusting for preschool enjoyment, and preschool enjoyment was associated with kindergarten general knowledge, adjusting for preschool general knowledge. Importantly, the predictive strengths of the bidirectional relations differed. The standardized coefficient for the association between preschool enjoyment and kindergarten general knowledge was double that between preschool general knowledge and kindergarten enjoyment. This is consistent with prior research showing cognitive benefits of positive affect in education (Sidi et al., 2018).

We kept our measure developmentally appropriate for preschool-age children by asking about familiar affects (i.e., fun/enjoy/excited rather than curiosity), and asked about school rather than learning because school is more concrete, but we believe that our measure may be an indicator of children's epistemic curiosity, which is defined as seeking new information through "activity that is wholly enjoyable" (p. 1589, Litman, 2008). Both enjoyment and curiosity are positive epistemic emotions (Pekrun, 2011), and, similar to developmental patterns of enjoyment (e.g., Spinath & Spinath, 2005), young children are naturally curious about their world and enjoy learning, but this can decline with schooling (Engel, 2013). Children perceive a disconnect between school and being curious by late elementary school, reporting lower relevance and enjoyment of learning related to curiosity (Post & Walma van der Molen, 2018, 2019). Our observed positive associations between school enjoyment and general knowledge are consistent with those observed between curiosity and knowledge (Wade & Kidd, 2019), and we suggest that future research should explore whether supporting school enjoyment could support curiosity and learning (Lamnina & Chase, 2019; Shah et al., 2018) with the potential of long-term benefits for motivation and learning, especially for science (Gottfried et al., 2016).

The current study also suggests that, as would be expected, preschool general knowledge predicted kindergarten general knowledge, and preschool enjoyment predicted kindergarten enjoyment, with a weaker association between preschool and kindergarten enjoyment than general knowledge. General knowledge is an important predictor of cross-domain learning but shows larger opportunity gaps at kindergarten than in other domains in at-risk populations (Grissmer et al., 2010). Thus, it is important to try to intervene to improve general knowledge to support school readiness. The weaker association and decline from preschool to kindergarten enjoyment suggests that there is malleability in enjoyment, and the stronger bidirectional association from prek enjoyment to kindergarten general knowledge may suggest that supporting early enjoyment could have the potential to benefit both later enjoyment and support the development of general knowledge.

Perhaps surprisingly, our covariates (age, gender, income status, Spanish-speaking) were unrelated to enjoyment, suggesting a somewhat universal early positive affect for school. Associations between preschool and kindergarten enjoyment and general knowledge did not differ in models in which we adjusted for teacher factors, suggesting somewhat robust associations. We observed slight differences in the associations when examined separately by subgroups, with preschool general knowledge no longer associated with kindergarten enjoyment for children from non–Spanish-speaking homes or males. This might be due to greater uncertainty in the measures for those groups, and we hesitate to draw any conclusions from these results as analyses were exploratory.

As with any study, there are several important limitations to consider when interpreting the results. First, these results are correlational in that we did not manipulate children's enjoyment or general knowledge at preschool. For a study of this scale, we could only include the single measure of enjoyment at each test time, and only the social studies and science subscales of general knowledge. Because our focus was to explore the student-level associations across time, we adjusted for classroom factors, so are not yet able to discuss what might be happening in classrooms to cause changes to enjoyment or general knowledge. It is especially important that future research needs to examine the effects of culture, race and ethnicity, and classroom and school factors on children's enjoyment and learning (DeCuir-Gunby

& Williams-Johnson, 2014). Our study focused on low-income children attending publicly funded preschool, and had strong representation from linguistically diverse children, which we see as a strength, but does limit the generalizability of the results to this specific population.

Despite the limitations, this study provides a preliminary exploration of the development of early school enjoyment and general knowledge from preschool to kindergarten. An important future direction is to explore factors that influence enjoyment and consider variations across subgroups. Enjoyment might be an important contributor to achievement and future career aspirations, which show differences in the subgroups in our exploratory analyses (i.e., females, Hispanic children; Riegle-Crumb et al., 2011). Nevertheless, the potential to promote enjoyment to support students' general knowledge learning could have important benefits. Recent work suggests that student-driven methods of learning in early education, such as play-based methods, are effective in supporting motivation and learning (Hirsh-Pasek & Golinkoff, 2011). Specifically, young children learn from guided play because their curiosities and interest drive the learning taking place, and future research should explore the benefits of promoting school enjoyment in early education with these methods (Hirsh-Pasek & Golinkoff, 2011; Jirout et al., 2018). Because of the decline in curiosity and school enjoyment with schooling, and with contemporary changes in early education becoming less play-based (Bassok et al., 2016), early education could be an important time to support students' curiosity by helping them find enjoyment in learning.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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