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Using self report surveys to measure PreK children's academic orientations: A psychometric evaluation☆

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ABSTRACT

As research continues to show the benefits of high-quality early childhood education, it is important to ensure that measures are available to assess the full impacts of these programs for student outcomes. Many achievement measures and observational measures exist, but there is a need for measures of children's experiences at the preschool level. Using data from 1102 preschool children, we evaluated the reliability and validity of a new measure of children's academic orientations, including their feelings about their teacher, school enjoyment, growth mindset, and perceived academic competence. We gave children a one-on-one 12-item assessment in which they responded to survey questions on a 3-point Likert scale. The psychometric qualities of the scale were evaluated using item factor analysis, invariance testing of the scale across important demographic groups, examination of item thresholds, and correlations of the scales with teacher-reported measures. Overall, the measures adhered to the hypothesized factor structure, were invariant across the diverse demographic groups in the sample, and correlated with teacher-reported outcomes in hypothesized ways. Results from the psychometric analysis are being used to update the scale for the next iteration.

Early educational experiences are important predictors of children's later educational outcomes and life experiences, as demonstrated in longitudinal follow-ups from experimental studies of intensive, high quality preschool (PreK) programs (Barnett, 1995; Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001). Beyond the knowledge they are exposed to in early childhood classrooms, children's academic orientations and the ways they feel about their learning environment have important consequences above and beyond observations of the quality of their learning environment (Schenke, 2018). However, measuring these beliefs is a difficult task when the aim is to get the information directly from children. At a high level, which constructs should be measured? If using survey-style approaches, how should items be phrased and what stimuli should children to respond to? These considerations must be determined while also obtaining sufficient psychometric properties. As such, the purpose of this paper is to rigorously evaluate the psychometric properties of four scales designed to measure aspects of young children's academic orientations: feelings about their teacher, growth mindset, school enjoyment, and perceived academic competence.

In this study, children's academic orientations were assessed in a large, diverse sample of public PreK children in the mid-Atlantic United States. We developed a short child survey using a combination of existing and new self-report instruments appropriate for PreK-aged children. Our goal was to create a measure of four academic orientations that could be administered quickly in educational settings, and demonstrate psychometric support for the separate constructs. We first review relevant literature on related theories and the ways children's academic orientations have been studied previously, focusing on the constructs measured in our survey. Next, we describe our measure and report on the results of a rigorous evaluation of the factorial structure, reliability, and validity of this new measure. Careful psychometric evaluations of survey instruments used with young children are uncommon but critical given the increasing use of these measures for gathering information on young children's school experiences and academic orientations. The assessment of these constructs is especially rele-

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vant in early childhood as these orientations develop in response to children's experiences in different learning environments, yet without a good measurement tool it is impossible to advance research on the development and impacts of these orientations. Specifically, we aimed to develop a measure of academic orientations that could be used to learn more about how to support children from low income families showing risk for low academic performance. The present study is among the first to employ and rigorously evaluate the suitability of survey-style instruments with low-income PreK children on multiple constructs.

1. Theories and importance of children's academic orientations

1.1. Theoretical background

The aim of the current study was to develop a measure of young children's feelings about their teacher, growth mindset, school enjoyment, and perceived academic competence. We define each of these constructs as follows: growth mindset beliefs are children's internal theories that their abilities and intelligence are malleable (Dweck, 2006); perceived academic competence is children's beliefs about whether they are good at different academic tasks (Marsh & Martin, 2011); school enjoyment refers to a child's positive feelings toward and experiences of school (Mantzicopoulos, Patrick, & Samarapungavan, 2008); and feelings about teacher refers to the child's perception of the teacher's feelings toward and relationship with them (Valeski & Stipek, 2001). Although early academic and cognitive abilities such as letter/number knowledge and executive functions are important for school success (Clark, Pritchard, & Woodward, 2010), children's beliefs about their abilities, both the level of ability and its malleability, are also strong influences of motivation and achievement (Dweck, 2006; Murayama, Pekrun, Lichtenfeld, & Vom Hofe, 2013). For example, Dweck's studies on children's implicit theories of intelligence show the belief that intelligence and skills are fixed is negatively associated with children's likelihood to approach and persist on learning tasks, whereas the belief that effort can improve their abilities – a growth mindset – relates to positive outcomes within and outside of school (Dweck, Chiu, & Hong, 1995; Dweck, 2006). These beliefs form over time, but they are influenced by very early experiences. For example, hearing praise related to process and effort when children are toddlers is associated with a higher likelihood of holding a growth mindset five years later, which further explains variation in standardized measures of math and reading in fourth grade (Gunderson et al., 2013, 2017). Importantly, children's learning orientations can serve as a buffer to SES-related achievement gaps (Claro, Paunesku, & Dweck, 2016).

Research on several motivational theories demonstrate that children's beliefs are associated with classroom engagement and learning. Related to our construct of children's perceived academic competence beliefs, expectancy-value (Wigfield & Eccles, 2000) and self-determination theories (Ryan & Deci, 2000), among others, argue that children's beliefs about their current level of abilities are associated with their expectancy of success on tasks and their motivation for learning, especially when faced with a challenge (Ferkany, 2008; Ryan & Deci, 2000; Wigfield & Eccles, 2000; Zimmerman, 2000). Expectancy-value theory also relates to the importance of our construct of school enjoyment, in which the theory emphasizes the importance of children's valuing of learning tasks (Wigfield & Eccles, 2000). Related to both school enjoyment and feelings about their teacher, self-determination theory describes the importance of students feeling a sense of belonging in classrooms, which can be supported by teachers (Ryan & Deci, 2000). Children's learning environments, and especially their relationship with their teacher, are important, as student–teacher relationships show consistent associations with academic measures (Stephanou, 2014; Zijlstra, Wubbels, Brekelmans, & Koomen, 2013). Prior work related to children's relationship with their teacher from an attachment theory perspective suggestis that younger children might be especially influenced by their relationship with teachers, relying on teachers as a support or "secure base" (Birch & Ladd, 1997; Bowlby, 1988). Although young children generally have positive affect related to learning and school (Nurmi & Aunola, 2005; Howse, Lange, Farran, & Boyles, 2003), studies have shown that positive attitudes decrease over time (Gottfried, Marcoulides, Gottfried, & Oliver, 2009; Spinath & Spinath, 2005). The need for data on children's attitudes at first exposure to the public school system is essential for establishing early indicators of the impacts of these settings on key developmental processes that have largely been studied in older children and adolescents.

1.2. Associations with academic achievement

Many studies have demonstrated relations between academic orientations and children's academic performance (e.g., Alexander, Entwisle, Blyth, & McAdoo, 1988; Aunola, Leskinen, & Nurmi, 2006; Dweck, 2006; Schenke, 2018). Generally, young children report high levels of enjoyment in school (Howse et al., 2003; Nurmi & Aunola, 2005). Children's enjoyment of learning is associated with later academic achievement (Stipek & Ryan, 1997; Viljaranta, Lerkkanen, Poikkeus, Aunola, & Nurmi, 2009) and indirectly influences their interest and learning experiences through teachers' perceptions of the child's learning ability (Upadyaya, Viljaranta, Lerkkanen, Poikkeus, & Nurmi, 2012). Enjoyment might be a protective factor against negative effects of behavior problems (Arnold, Kupersmith, Voegler-Lee, & Marshall, 2012). Similarly, holding a growth-mindset can be a protective factor against academic challenges for low-income students (Claro et al., 2016), and studies consistently show associations with motivation and learning in experimental and non-experimental research (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Blackwell, Trzesniewski, & Dweck, 2007). Despite some evidence that competence and achievement are not associated (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Howse et al., 2003), other studies show that children's competence beliefs have positive associations with academic achievement in K and 1 st grade (Bouffard, Marcoux, Vezeau, & Bordeleau, 2003; Mantzicopoulos et al., 2008).

The importance of children's feelings about teachers also matter for academic performance. Teacher–student relationships are associated with student outcomes (Davis, 2003); meta-analysis and comprehensive reviews of teacher–student relationship research indicate that more positive relationships are associated with students' learning, motivation, and engagement (Martin & Dowson, 2009; Roorda, Koomen, Spilt, & Oorda, 2011) and that students at-risk of having or who have poor relationships with teachers have generally worse educational outcomes (McGrath & Van Bergen, 2015). When using student-reported measures, young children's ratings of their relationship with teachers are associated with teacher reports of the relationship (Spilt, Koomen, & Mantzicopoulos, 2010; Valeski & Stipek, 2001), children's engagement (Papadopoulou & Gregoriadis, 2017), problem behaviors (Mantzicopoulos, 2005), and academic performance (Stephanou, 2014; Zijlstra et al., 2013).

There are likely interrelations among these factors, for example mindset theories influence children's learning and motivation in ways that influence perceived competence (Elliot & Dweck, 2005) and enjoyment (Smiley & Dweck, 1994), and both perceived and actual competence is associated with children's enjoyment of learning (Mantzicopoulos et al., 2008). When a teacher perceives a closer relationship with a child, this is associated with chil-

dren having higher self-concept (Hughes & Chen, 2011; Jõgi, Kikas, Lerkkanen, & Mägi, 2015). Further, evidence shows that learning orientations develop early and impact later academic experiences, suggesting a need for assessments that allow these factors to be studied during children's earliest academic years. Given the expansion and wider focus on PreK, assessing the relevance of these constructs at an age in which children are increasingly exposed to settings with educational intent is critical. However, this presents challenges in that research on these different constructs typically includes questionnaire measures developed for older children or has relied on teacher-reports that have not been validated with children's actual experiences. We briefly describe some examples of both teacher report and child survey measures below.

2. Prior measures of children's academic orientations

2.1. Teacher measures (reports)

Given their repeated interactions with children in learning situations and classroom contexts, teachers are perhaps the most prevalent source of information on schoolchildren's motivation, competence, enjoyment, and relationships with peers and adults. Teacher reports on these constructs are often associated with children's learning (e.g., Hirvonen, Tolvanen, Aunola, & Nurmi, 2012; Hughes & Chen, 2011; Jõgi et al., 2015). Importantly, teachers' reports of students' academic orientations are moderately correlated with reports from subsequent teachers, suggesting teachers are somewhat reliable reporters of children's beliefs and skills (Hajovsky, Mason, & McCune, 2017; Jerome, Hamre, & Pianta, 2009). However, one of the lessons from research on older elementary-aged children is that children have unique insights into their own experiences, academic beliefs, and skills that are strongly associated with their learning, motivation, and engagement (Wigfield et al., 1997). Similarly, in contrast to teacher ratings of the student–teacher relationship, children's own perceptions of this relationship are stronger predictors of their school liking and avoidance (Murray, Murray, & Waas, 2008), as well as their self-efficacy (Hughes, 2011), suggesting that children may be better sources of information. Using survey style instruments with PreK-aged children is rare in applied settings but is much more common in controlled laboratory settings. A variety of approaches have been utilized in prior research to gather data directly from young children on their self-beliefs and academic orientations.

2.2. Child measures

In many studies of young children, observational measures of behavior or coding of children's language during story telling or while completing a task are used to measure children's learning orientations (e.g., Dweck et al., 1995; Li & Wang, 2004; Smiley & Dweck, 2004; Stipek, Feiler, Daniels, & Milburn, 1995; White, 2016). Although these types of measures can provide valid information on children's perceptions about themselves and others, they also require careful administration, can be time intensive both to collect and code, and are not feasible for large-scale data collection in early childhood classrooms.

Alternatively, several studies have attempted to measure young children's perceptions using variations of survey-style measures. For example, in a study of children's perceived self-competence and enjoyment of learning, Mantzicopoulos, Patrick, Strati, and Watson (2017) asked children to choose which of two statements given by puppets best matched their own beliefs or experience. This dichotomous item format has also been used for competence ratings by slightly older children who can respond to similar dichotomous statements without puppets (Onatsu-Arvilommi, Nurmi, & Aunola, 2002). In measuring mindset, Onatsu-Arvilommi et al. (2002) used similar methods with kindergarten-age children, asking them to select which of two conflicting statements, such as persisting vs. giving up when faced with a challenge, matched their own preference. These statements typically ask about children's response to challenges, such as enjoying a task that was challenging but the child could learn more, or choosing a task based on the task being easy to complete, similar to mindset survey measures used with older children (Dweck, 2007; Gunderson et al., 2013).

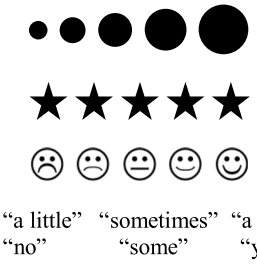

Fig. 1. Example survey response scales used with young children.

Preschoolers are also able to respond to verbal questions using a binary or limited response scale, with the response scale indicated by shapes rather than numbers (Mantzicopoulos et al., 2017; Valeski & Stipek, 2001), which is the approach taken in the current study. As shown in Fig. 1, scales are sometimes presented as increasingly larger shapes (e.g., circles), selecting among an increasing number of shapes (e.g., stars), smiley-face scales, or using qualitative terms. Using these methods to assess young children's perceptions of teacher support, Mantzicopoulos and Neuharth-Pritchett (2003) developed a multidimensional measure covering child-perceived teacher warmth, conflict, and autonomy. These three factors were supported in factor analyses, with coefficient alpha reliabilities of the scales ranging from a low of 0.66 (autonomy) to a high of 0.80 (warmth) for preschoolers. In the full sample (PreK-1st grade), validity for the scale was supported by positive associations between the warmth scale and teacher reports of the child's secure attachment, and conflict negatively associated with teacher ratings of cooperation and self-control. Enjoyment of learning has been measured in PreK children using surveys with verbal or pictorial items (see Fig. 1), with items such as, "How fun are things you do at school?" and "How much do you like math tasks?" (Nurmi & Aunola 2005; Pakarinen et al., 2010; Valeski & Stipek, 2001). Two such measures are widely used in prior studies: the Task Value Scale for Children (TVS; Nurmi & Aunola 2005) and the Feelings About School (FAS; Valeski & Stipek, 2001). In both scales, although psychometric information on the instrument was presented, it was not complete enough to evaluate the full utility of these scales. For perceived academic competence, there is some evidence for domain-specific beliefs in children as young as age seven, (i.e., first grade students, Eccles, Wigfield, Harold, & Blumenfeld, 1993; Wigfield et al., 1997) and eight (i.e., second grade; Schneider, Lotz, & Sparfeldt, 2018), however studies tend to assess perceived academic competence as domain general within subjects, focusing on whether children believe they are good at typical school tasks in math, science, or reading (e.g., Mantzicopoulos et al., 2008), and only occasionally assess domain-specific competence factors (e.g., Valeski & Stipek, 2001).

3. Present study

The use of student surveys to measure elementary and secondary students' academic orientations is a well-established and flourishing research endeavor. Increasingly, early childhood researchers and practitioners are interested in using survey-like

instruments to measure these orientations in PreK and early elementary-aged children. The initial wave of results from this work are encouraging, as reviewed above, though much of the prior research assessing these orientations was conducted on K-aged and older children, and often focused on measuring single learning orientations. Available evidence suggests that children's self-reported feelings about their teacher, enjoyment of school, motivation (growth mindset), and perceived academic competence are predicted by aspects of the classroom environment and are associated with important educational outcomes, including children's academic achievement, motivation, and even later academic success.

However, of the existing research published on these academic orientations, few have conducted rigorous psychometric analyses of the employed measures (c.f., Guay et al., 2010; Zijlstra et al., 2013), and none have been conducted on measures used specifically with PreK children. This study thus fills a gap in the existing research by assessing the factorial structure, reliability, and validity of a short measure that was administered to more than 1,100 ethnically and linguistically diverse PreK children in one of the largest public school districts in the United States. Employing a multidimensional scale that measures children's feelings about their teacher, their motivation, self-beliefs, and emotional experiences in school allows us to determine the degree to which these are separate constructs that can be detected when PreK-aged children are the reporters. Assessing academic orientations at an age in which children are increasingly exposed to organized educational settings, such as PreK, is critical if these assessments are to be used as indicators not only of children's experience, but as early indicators of the impacts of educational settings on the development of these orientations.

3.1. Study aims and research questions

The first aim of this study was to evaluate the psychometric qualities of the newly-developed academic orientations survey. To this end, we were concerned with the degree to which inter-item correlations were stronger for items belonging to the same theoretical construct relative to items from other constructs. Next, we considered the factor structure of the full measure, specifically whether items loaded onto the appropriate theoretical construct and the extent of any cross-loading onto other factors. Given the ordinal nature of the items, we employed an item factor analytic approach that allows us to examine the extent to which the survey items represent variations across a wide range of children's academic orientations (Wirth & Edwards, 2007). The degree to which the factor structure of the instrument held across different groups of children (i.e., measurement invariance) was investigated next so that we could examine mean differences in the measured constructs across children.

The second aim of the study was to investigate the convergent validity of the academic orientations survey, specifically whether the constructs related to similar teacher-reported constructs. We hypothesized the following:

1. Children's feelings about their teacher will be positively correlated with teacher reports of closeness and negatively correlated with teacher reports of conflict.
2. Children's growth mindset will be correlated with teacher-reported frustration tolerance given that scale's emphasis on overcoming failure and dealing with adversity.
3. Children's school enjoyment and perceived academic competence will be positively associated with teacher-reported task orientation.

4. Method

4.1. Participants

Participants were 1,102 4- to 5-year-old children (mean of 53 months of age with a standard deviation of 3.5 months) enrolled in publicly-funded PreK in a large school district in the mid-Atlantic United States. The student population of the school district was approximately 200,000 in the 2016–2017 school year in which study data were collected. The parents of all children in the public PreK program were invited to allow their children to participate in the observational study, which encompassed a broader set of activities than detailed in the present study. Approximately 81% of parents consented to have their children enroll in the study. To participate in publicly-funded PreK, study children were classified as economically disadvantaged (200% of the federal poverty level). The sample of children came from a diverse set of backgrounds including Latino (56%), African American (18%), Asian (10%), white (4%), and the remaining 10% identified as mixed race, Native American, or other racial background. In terms of languages spoken at home, 58% of families spoke Spanish, 19% spoke English, and 24% spoke a non-Spanish or -English language. Half of the sample were identified as female by their parents. Fully 61% of children met the criteria for being below the Federal poverty line for 2017 income-to-needs ratio. Teachers were also consented to participate in the study, and 89% of the 139 eligible PreK teachers consented to allow study personnel to come into their classroom for data collection.

4.2. Procedures

The motivation surveys were administered to children as part of the direct assessment battery for the larger study, coming after the children had completed cognitive and executive functioning assessments. The survey was conducted like an interview, with the assessors, who were trained by the PI team, asking children questions (the survey items) to which children indicated their level of agreement by pointing to one of three increasingly larger circles, corresponding to less or more agreement. The full survey script is contained in the electronic supplementary material. Direct assessors first read the directions for the survey and administered two practice items to check for children's understanding of the directions and how to indicate their responses (by pointing to one of the circles). For each survey item, there were staged instructions such that if children did not respond by pointing to a circle, the assessor would first say, "Show me by pointing to one of the circles how much. . ." If the child did not respond, then the assessor would point to each circle and indicate what it would mean to pick that response option. If the child still did not point to a circle, then their response for that item was left blank. Non-response to survey items was rare, of the 1,102 children surveyed, only 11% had one or more non-responses. Completion of the survey took children 4.25 min on average (standard deviation = 1.75 min).

4.3. Measures

4.3.1. Child survey

The child survey measure was created from a combination of existing surveys and newly-developed scales for this project. Response options for all surveys were identical. As described above, children pointed to one of three increasingly-sized circles to indicate how much they agreed with the statement, whether *a little bit*, *some*, or *a lot*. Given the ordinal nature of the scale, the alpha reliability coefficient is not appropriate, and we therefore do not report it (Viladrich, Angulo-Brunet, & Doval, 2017). Instead, we report the ordinal omega reliability coefficient (ω_o), which is appropriate for congeneric measures (i.e., factor analysis models in which the factor

loadings are not expected to be equal, or tau-equivalent). Ordinal omega is calculated using the polychoric correlation matrix, and the reliability coefficient is based on the covariation among underlying continuous variables comprising the scale (Gadermann, Guhn, & Zumbo, 2012; Viladrich et al., 2017). We note ahead of time that with only three items per scale, reliability is expected to be lower than the 0.7 level considered acceptable for scale development (Nunnally & Bernstein, 1978). Initial piloting of the survey with children from the school district led to changes in the directions and wording of items and response options. We describe below, for each scale, when these changes led to a significant deviation from an established survey.

4.3.1.1. Feelings about teacher. Children's feelings about their teacher were assessed using items from Valeski and Stipek's (2001) Feelings about school (FAS) survey measure. The items were slightly altered to increase interpretability for PreK children. For all items, we added "How much" to the beginning of the item so that children understood that a binary response was not possible, and to conform with the response options they were presented. Additionally, the FAS item "How does (teacher name) feel about you" was changed to "How much does your teacher *like* you" based on pilot testing in which children had trouble understanding the word "feel."

4.3.1.2. School enjoyment. To measure children's enjoyment of school, we adapted items from the Achievement Emotions Questionnaire – Elementary Students (AEQ-ES) class-related enjoyment scale, which was originally validated in 2nd and 3rd grade German and American samples and focused on mathematics (Lichtenfeld, Pekrun, Stupnisky, Reiss, & Murayama, 2012). The AEQ-ES uses statements as prompts, and we altered these to be questions focused on a child's positive emotions related to *school*. The item "Math is fun for me" became "Is school fun?" and "I enjoy math class" became "Do you enjoy school?" Finally, to maximize interpretability for the younger children in our sample; the AEQ-ES item "I look forward to math class" was altered to "Are you excited to go to school?"

4.3.1.3. Growth mindset. We created a novel survey of children's growth mindset for this project. For each item, children were asked to respond in reference to a stimulus of a complicated block castle built from wooden blocks commonly found in PreK classrooms (see electronic Supplementary material). The first item "Could you figure out how to build this castle if you tried really hard," assessed children's belief that hard work could lead to success. The second item, "If you got stuck building this castle, how hard would you keep trying," tapped into whether they would continue building or give up after failure. And the third item, "Do you think you would get better at building the castle if you practiced," assessed whether children believed they could improve through practice.

4.3.1.4. Perceived academic competence. Children's beliefs about their academic abilities were assessed using items that covered the broad domains of knowledge PreK children are exposed to, including general school work, math activities, and reading activities. In each case the item started with "How good are you at. . .", and the ending varied based on the domain, but was tailored to the types of activities associated with each domain in a PreK classroom. For general school work, the item ended with ". . .the work your teacher gives you," for math ". . .numbers and counting," and for reading ". . .reading letters and words."

4.3.2. Teacher rating scales

Teacher ratings of each child were used to evaluate convergent validity of the child survey scales. As with the child survey scales, the evaluation of reliability of these models was established by factor analyses in which the items were treated as ordinal data, and we report on item factor analysis model (IFA) fit. Given the 1–5 Likert scaling of these items, we also report on their Omega reliability coefficients from models in which we treated the responses as continuous but used robust estimation to deal with any non-normality in the items (ESTIMATOR = MLR in Mplus). The distribution of responses to all teacher-reported items are contained in Appendix Table 1 in the electronic Supplementary materials.

4.3.2.1. Student–teacher relationship scale. Teachers assessed their closeness (4 items) and conflict (5 items) with each of their children using the student–teacher rating scale (Pianta, 2001). The closeness scale included the following items: "I share an affectionate, warm relationship with this child," "This child spontaneously shares information about himself/herself," "It is easy to be in tune with what this student is feeling," "This child openly shares his/her feelings and experience with me." The conflict scale included "This child and I always seem to be struggling with each other," "This child easily becomes angry at me," " Dealing with this child drains my energy," "When this child arrives in a bad mood, I know we're in for a long and difficult day," and "This child's feelings toward me can be unpredictable or can change suddenly." Responses were given using a 5-item Likert scale (1 = definitely does not apply, 3 = neutral, not sure, and 5 = definitely applies). A two-factor IFA demonstrated acceptable fit to the STRS data (χ^2: 270.17(25), RMSEA = 0.095, CFI = 0.983, TLI = 0.975). Closeness and conflict were negatively-correlated with one another ($r = -0.38$, $p < .001$). The covariance between the residual errors of two items, "This child spontaneously shares information about himself/herself" and "This child openly shares his/her feelings and experience with me" were freely-estimated; doing so significantly improved model fit ($p < .001$). Omega reliability for closeness was 0.80 and for conflict was 0.90.

4.3.3. Student competencies

Teachers rated each child on three general competencies using the teacher–child rating scale (Hightower, Work, Cowan, Lotyczewski, & Spinell, 1987). On a 1–5 Likert scale (1 = not at all, 3 = moderately well, 5 = very well), teachers were directed to indicate how well a given characteristic described the child. The task orientation comprised five items ("completes work," "well organized," "functions well even with distractions," "works well without adult support," and "a self-starter"). The peer social skills scale comprised five items ("has many friends", "is friendly toward peers," "makes friends easily," "classmates wish to sit near this child," and "well-liked by classmates"). The frustration tolerance scale comprised four items ("accepts things not going his/her way," "ignores teasing," "copes with failure," and "tolerates frustration"). A three-factor IFA demonstrated acceptable fit to the SCSS data (χ^2: 705.51(74), RMSEA = 0.089, CFI = 0.988, TLI = 0.985). All latent factors were positively correlated with one another, with correlations ranging from $r = 0.68$–0.72. Omega reliabilities for the three measures were 0.91, 0.91, and 0.94 for respectively, frustration tolerance, task orientation, and social skills.

4.4. Analytic strategy

Our strategy for assessing the psychometric quality of the scales was to employ both exploratory and confirmatory analytic techniques owing to the fact that this instrument, being newly created, has never been assessed with child response data of a sufficient sample size to determine the adequacy of its hypothesized factor structure. Despite ultimately using a confirmatory analytic approach, we cannot claim that we are in fact confirming the factor structure; this must be done on future samples gathered in other studies.

Table 1
Child survey item descriptive statistics and polychoric correlations.

		Tchr1	Tchr2	Tchr3	Enjoy1	Enjoy2	Enjoy3	Grow1	Grow2	Grow3	Self1	Self2	Self3
1. How much does your teacher care about you?	Tchr1	1											
2. How much does your teacher like you?	Tchr2	0.11	1										
3. How much do you like your teacher?	Tchr3	0.19	0.45	1									
4. Is school fun?	Enjoy1	0.14	0.15	0.25	1								
5. Are you excited to go to school?	Enjoy2	0.13	0.27	0.35	0.57	1							
6. Do you enjoy school?	Enjoy3	0.11	0.24	0.32	0.47	0.55	1						
10. Could you figure out how to build this castle if you tried really hard?	Grow1	0.08	0.10	*0.06*	0.12	0.20	0.14	1					
11. If you got stuck building this castle, how hard would you keep trying?	Grow2	0.15	0.15	0.10	0.15	0.11	0.13	0.32	1				
12. Do you think you would get better at building the castle if you practiced?	Grow3	*0.08*	0.19	0.18	0.20	0.27	0.31	0.37	0.35	1			
13. How good are you at the school work your teacher gives you?	Self1	0.24	0.28	0.31	0.31	0.35	0.28	0.23	0.16	0.30	1		
14. How good are you at numbers and counting?	Self2	0.13	0.29	0.25	0.25	0.22	0.34	0.20	0.15	0.28	0.43	1	
15. How good are you at reading letters and words?	Self3	0.13	0.20	0.20	0.25	0.25	0.30	0.15	0.11	0.22	0.40	0.44	1
% of responses in category 1 (a little bit)		23%	14%	16%	22%	23%	24%	37%	27%	22%	18%	19%	29%
% of responses in category 2 (some)		14%	17%	14%	9%	13%	14%	11%	12%	12%	11%	12%	16%
% of responses in category 3 (a lot)		63%	69%	70%	69%	65%	62%	52%	61%	66%	72%	69%	55%

Note: N = 1102. All correlations are significant at $p < 0.05$ unless italicized, indicating non significance.

To address aim 1 of our study we conducted exploratory structural equation modeling (ESEM) to examine the extent to which items theoretically associated with each factor cross loaded onto other factors (Marsh, Morin, Parker, & Kaur, 2014). Items with high cross-loadings onto factors they are not theoretically aligned with do not provide unique information about that factor. Items with low cross-loadings on non-theoretically aligned factors are desirable, and ESEM is ideally suited for assessing the degree to which the instrument meets such a definition of simple structure. We next conducted confirmatory item factor analysis (IFA; see Wirth & Edwards 2007 for a review) to examine the model fit of the ESEM identified and hypothesized factor structure as well as understand to what extent item responses represented the full range of children's estimated academic orientations. This is done by examining the threshold parameters of the items. Because we have three response categories, two threshold parameters are estimated. Threshold parameters represent the point on the continuous latent response scale where an individual has a 50% probability of choosing above that response category. They provide information about where along the ability distribution items provide the most information and can be used to understand the distance between response categories. We then conducted invariance testing of our items across several demographic groups (gender, whether Spanish was spoken at home, whether other language – not Spanish or English – was spoken at home, and whether the child was below the Federal poverty threshold) to understand if items functioned similarly across groups and to estimate latent mean differences across these groups. To address the second aim, we examined latent correlations between the child scales and the teacher scales.

All analyses were conducted with Mplus version 8 (Muthén & Muthén, 2017) using type = complex to account for children's nesting within PreK classrooms and weighted-least squares means and variances estimation (WLSMV) to accommodate the ordinal nature of the response scale. In terms of missing data, 89% of children responded to all survey items and most of the remaining children responded to all but one item. All items had missingness rates of less than 5%. WLSMV uses pairwise deletion, which assumes data is missing completely at random, and so we re-ran the CFA and concurrent validity models using full-information maximum likelihood to account for the missing data. The parameter estimates (factor loadings and correlations) were all within .05 of each other in the two estimation approaches, and the patterns of significance led to the same conclusions. We therefore report the WLSMV results below. Regarding nesting, there were, on average, 10 children per teacher (range = 1–17), and item-level ICCs were very low, between 0.001 and 0.04, indicating minimal variance at the teacher level. We likewise examined variance at the assessor level, finding almost no appreciable variance between assessors on most items.

5. Results

5.1. Descriptive statistics

Table 1 shows the polychoric correlations and the response distributions of the items across the three response categories. Across all items, most participants endorsed the third response category (indicating their answer to the question posed was "a lot") ranging from 52% (Could you figure out how to build this castle if you tried really hard?) to 72% (How good are you at the school work your teacher gives you?) of responses depending on the item. Correlations among items within the same scale were stronger than correlations among items across scales. An exception was the first item of the feelings about teacher scale ("How much does your teacher care about you?"), which had very low correlations with the other two items in the scale ($r = 0.11$ and $r = 0.19$ with item 2 and item 3 of the scale, respectively). The first teacher item had a stronger correlation ($r = 0.24$) with the first perceived academic competence item ("How good are you at the school work your teacher gives you?"). The second and third teacher items had correlations of a similar magnitude (*r*s between 0.20 and 0.31) with the perceived academic competence items suggesting some potential for conceptual overlap in the items comprising these hypothesized constructs.

5.2. Factor structure

We first examined the extent to which items cross-loaded onto multiple factors using ESEM with the WLSMV estimator (see Appendix Table 2 in the electronic Supplementary material). All cross loadings were minimal (none larger than 0.15) and none were significantly different from zero suggesting that cross loading of items was not very strong among the entire set of items. We therefore moved forward with the theoretical confirmatory IFA, with Table 2 showing the standardized factor loadings and the latent factor correlations from this model. Model fit for the 4-factor solution was good with $\chi^2(48) = 65.60$, $p < 0.05$; root mean square error of approximation (RMSEA) = 0.02; Configural Fit Index (CFI) = 0.99; Tucker-Lewis Index (TLI) = 0.98 (Hu & Bentler, 1999). Standardized

Table 2
Standardized loadings and latent factor correlations from confirmatory IFA.

	Feelings about teacher	School enjoyment	Growth mindset	Perceived academic competence
1. How much does your teacher care about you?	0.33 (0.06)			
2. How much does your teacher like you?	0.60 (0.05)			
3. How much do you like your teacher?	0.69 (0.05)			
4. Is school fun?		0.67 (0.04)		
5. Are you excited to go to school?		0.79 (0.03)		
6. Do you enjoy school?		0.73 (0.04)		
10. Could you figure out how to build this castle if you tried really hard?			0.52 (0.05)	
11. If you got stuck building this castle, how hard would you keep trying?			0.47 (0.05)	
12. Do you think you would get better at building the castle if you practiced?			0.78 (0.04)	
13. How good are you at the school work your teacher gives you?				0.72 (0.04)
14. How good are you at numbers and counting?				0.66 (0.04)
15. How good are you at reading letters and words?				0.58 (0.04)
Latent factor correlations				
Feelings about teacher	1	0.57	0.36	0.63
School enjoyment		1	0.42	0.6
Growth mindset			1	0.53
Perceived academic competence				1

Note: Loadings are standardized, standard errors are in parentheses. All loadings and latent factor correlations are significant at $p < 0.001$.

factor loadings for each of the constructs ranged from 0.33 to 0.69 for the feelings about teacher factor, 0.67–0.79 for the school enjoyment factor, 0.47–0.78 for the growth mindset factor and 0.58–0.72 for the perceived academic competence factor. Correlations among latent factors ranged from 0.36 (for growth mindset and feelings about teacher) to 0.63 (between perceived academic competence and feelings about teacher) suggesting adequate differentiation across the constructs.

The threshold parameters for the items are given in Appendix Table 3 in the electronic Supplementary material. Threshold parameters are placed on a theta scale and can be interpreted like difficulty parameters for binary responses in item response theory models. Overall the threshold parameters for the items are low, ranging from −1.07 to −0.05 on the theta scale (this typically ranges from −3 to 3). For example, for a child to have a 50% probability of choosing the third response category ("a lot"), a participant has to have an underlying trait value of −0.32 for "How much does your teacher care about you?" on the feelings about the teacher scale. The second item on the growth mindset scale ("if you got stuck building this castle, how hard would you keep trying?"), for example, has a threshold of −0.05 for a response of "a lot." Overall, the low and negative thresholds suggest that these scales provide much information about individuals on the low end of the distribution of these traits and not as much information about children on the high end of the ability distribution. These threshold parameters are consistent with the observed response distributions in Table 1 which shows that most children (64% on average) chose the third response category ("a lot").

5.3. Scale reliabilities

We estimated ordinal omega reliabilities for each of our scales given the ordinal nature of the responses and the non-equal factor loadings across the items (Viladrich et al., 2017). These reliability coefficients represent the ratio of true score variance to observed score variance, and values are interpreted similarly as the more commonly used alpha coefficients. Ordinal omega (ω_o) reliabilities for the scales were as follows: feelings about teacher $\omega_o = 0.57$, enjoyment $\omega_o = 0.78$, growth mindset $\omega_o = 0.58$, perceived academic competence $\omega_o = 0.69$.

5.4. Invariance testing and mean differences

Next, we conducted invariance testing to understand whether there were differences in how distinct groups of children responded to the items. We investigated invariance separately for each of the following four groups of children: (a) boys (in comparison to girls); (b) children whose families spoke Spanish at home (in comparison to students who spoke English at home); (c) children who spoke a language other than English or Spanish at home (in comparison to English and Spanish speakers); and d) children below the poverty threshold (in comparison to children above the threshold). Three types of invariance were assessed, starting with configural invariance, in which the factor structure is the same across groups. Metric invariance was next considered, in which the factor structure and the factor loadings are equal across groups. Finally, we estimated a scalar invariance model, in which the factor structure, factor loadings, and error variances of the items are the same across groups. Obtaining scalar (or strong) measurement invariance is necessary to determine mean trait-level differences in the latent factors across groups, ensuring that any observed differences are not due to differing measurement or factor structure of the constructs across groups.

We evaluated measurement invariance by examining differences in model fit when the parameters of interest were constrained to be equal across groups relative to when the same parameters were estimated freely across groups. The cutoff used for determining equivalent fit of less and more restrictive models was whether the more restrictive model had a change in CFI of less than 0.01 relative to the less restrictive model (Cheung & Rensvold, 2002). Table 3 shows these results. Strong measurement invariance was found across all groups examined with changes in CFI from the less to more restrictive models ranging from 0.000 to 0.004. Model fit indices for all the invariance models are shown in Appendix Table 4 of the electronic Supplementary material.

Based on the results from the scalar invariant models, we examined differences in the means of the latent variables across groups (Table 3). In a latent variable framework, exact means are not usually estimated but rather differences in means are estimated across groups. Overall, girls had more positive feelings about their teachers than did boys (mean difference of 0.14, $se = 0.05$, $p < 0.01$).

Table 3
Invariance tests and mean differences.

	Girls	Spanish at home	Non-Spanish/English at home	Low income
Tests of model fit				
Config vs. metric	CFI Δ = 0.001	CFI Δ = 0.004	CFI Δ = 0.002	CFI Δ = 0.001
Metric vs. scalar	CFI Δ = 0.000	CFI Δ = 0.002	CFI Δ = 0.002	CFI Δ = 0.002
Mean differences				
Teacher	0.14 (0.05)**	−0.06 (0.05)	0.00 (0.05)	0.01 (0.05)
Enjoyment	−0.03 (0.08)	−0.19 (0.08)*	0.09 (0.12)	−0.04 (0.09)
Growth mindset	−0.15 (0.05)**	−0.02 (0.08)	0.00 (0.07)	−0.01 (0.08)
Perceived academic competence	−0.16 (0.09)	−0.16 (0.10)	0.23 (0.16)	0.10 (0.14)

Note: comparison groups are, in order, boys, children from non-Spanish speaking homes, children from Spanish or English speaking homes, and non-low income children.
* $p < 0.05$.
** $p < 0.01$.

Table 4
Convergent validity latent correlations.

	Feelings about teacher	School enjoyment	Growth mindset	Perceived academic competence	Closeness	Conflict	Task orientation	Peer social skills	Frustration tolerance
Feelings about teacher	1	0.51***	0.30***	0.56***	0.24***	−0.16***	0.22***	0.17***	0.15***
School enjoyment		1	0.39***	0.55***	0.11*	−0.10*	0.11**	0.10**	0.04
Growth mindset			1	0.50***	0.08+	−0.12*	0.08+	0.09*	0.11*
Perceived academic competence				1	0.07	0.05	0.17***	0.12**	0.04
Closeness					1	−0.39***	0.50***	0.60***	0.34***
Conflict						1	−0.57***	−0.58***	−0.78***
Task orientation							1	0.69***	0.67***
Peer social skills								1	0.71***
Frustration tolerance									1

+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Girls as compared with boys, had lower growth mindset (mean difference of 0.15, *se* = 0.05, $p < 0.01$). Children who spoke Spanish at home had lower estimates of school enjoyment than did children who did not speak Spanish at home (mean difference of 0.19, *se* = 0.08, and $p < 0.05$). All other mean differences in the constructs across the examined groups were not significantly different from zero.

5.5. Convergent validity

Finally, we report correlations of child reports and teacher reports of children (descriptive statistics of the measurement properties of these constructs are reported in the measures section) as evidence of convergent validity (Table 4). The convergent validity model was run with the four child scales and the five teacher report scales and had good fit to the data ($\chi^2(523) = 1013.18$, $p < 0.001$; RMSEA = 0.03; CFI = 0.98; TLI = 0.98).

Children's reports about their feelings about their teacher and teacher reports of closeness with the child were correlated at $r = 0.24$ ($p < 0.001$) and their reports of school enjoyment and closeness were correlated at $r = 0.11$ ($p < 0.05$). Teacher reports of child conflict were hypothesized to be negatively correlated with children's reports of their motivation and were found to be negatively correlated for all but one construct ($r = -0.16$, $p < 0.001$ for feelings about the teacher; $r = -0.10$, $p < 0.05$ for school enjoyment; and $r = -0.12$, $p = 0.05$ for growth mindset). Teacher's reports of children's task orientation were positively correlated with children's reports of their academic orientations ($r = 0.22$, $p < 0.001$ for feelings about the teacher; $r = 0.11$, $p < 0.001$, for school enjoyment; and $r = 0.17$, $p < 0.001$ for perceived academic competence). Teacher's reports of the children's peer social skills were significantly correlated with all constructs pertaining to children's self-reported academic orientations ($r = 0.17$, $p < 0.001$ for feelings about the teacher; $r = 0.10$. $p < 0.05$ for school enjoyment; $r = 0.09$, $p < 0.05$ for growth mindset; and $r = 0.12$, $p < 0.01$ for perceived academic competence, respectively). Finally, teacher reports of the children's tolerance for frustration were correlated with children's feeling about the teacher ($r = 0.15$, $p < 0.001$) and their growth mindset ($r = 0.11$, $p < 0.05$). As a sensitivity test, we also examined the correlation pattern after controlling for a child's language ability (i.e., a child's scores on two Woodcock–Johnson III tests: Letter-Word Identification and Picture Vocabulary). This analysis revealed a very similar pattern of correlations as reported above (see Appendix Table 5 in the electronic Supplementary material).

6. Discussion

This paper presented psychometric evidence of reliability and validity on a new brief survey measure designed to assess PreK children's academic orientations, focusing specifically on their feelings about their teacher, school enjoyment, growth mindset, and perceived academic competence. Although not an exhaustive list of all possible academic orientations, these four constructs are shown to be both influenced by the school environment and important predictors of academic and non-academic outcomes in prior research. We found that the items mapped onto their hypothesized factors in both exploratory (ESEM) and confirmatory (CFA) approaches, with no significant cross-loading of items. Correlations between the latent factors were all positive (as expected) and of a magnitude that indicated sufficient distinctiveness (ranging from $r = 0.36$ to 0.63). The scales were determined to be strongly invariant across children of different genders and income levels, and across children who spoke different languages at home. Reliabilities of the individual scales were lower than typically-accepted levels in measurement development work, with ω_0 reliability coefficients ranging from 0.57 to 0.78. However, convergent validity

analyses showed that the academic orientation constructs were differentially correlated with teacher-reported measures in expected directions.

As anticipated, school enjoyment and perceived academic competence were positively correlated with teacher reports of a child's task orientation and peer social skills whereas growth mindset was positively correlated with teacher-reported frustration tolerance. Relative to boys, girls had more positive feelings about their teacher, which is consistent with prior studies (Birch & Ladd, 1997; Hamre & Pianta, 2001; Ramey, Lanzi, Phillips, & Ramey, 1998; Valeski & Stipek, 2001). Because this study is part of a longitudinal project, it will be possible to examine whether positive perceptions of student relationships with teachers influence academic engagement and achievement and, importantly, how student–teacher relationships change over time from the students' perspective.

Boys showed higher growth mindsets than girls in our sample. Numerous studies have demonstrated the importance of early parental and teacher influence on children's developing mindset beliefs, and studies show that teachers use different levels of person and effort praise with boys and girls. Boys are observed to hear more effort praise, which is associated with developing a growth mindset, and girls tend to hear more person or ability attributions, which are associated with fixed mindset beliefs (Dweck, Davidson, Nelson & Enna, 1978; see also Dweck & Bush, 1976; Gunderson et al., 2013, 2017). Recent research shows that stereotypical beliefs about ability favoring boys do not appear until age six, consistent with our finding that there were no gender differences in children's perceived academic competence. However, children as young as four are impacted by subtle language differences associated with person vs. effort attributions, which are central to a growth or fixed mindset (Cimpian, Arce, Markman, & Dweck, 2007). These results contribute to the limited research on preschoolers' individual differences in growth mindset, suggesting that gender differences in mindset occur at this early age, and it will be important to further explore this difference and test if it replicates, as well as possible impacts it might have on other academic orientations and outcomes.

Finally, results also showed that children who spoke Spanish at home had lower school enjoyment than children who spoke a non-Spanish language at home. There is some research suggesting that students in this subgroup are challenged with learning not just academic content, but also U.S. culture and possibly developing language skills that impact their school experience, as well as experiencing greater academic pressure (Abedi & Gándara, 2006), perhaps leading to lower enjoyment. Also possible, although unexamined here, is that these children might be experiencing discrimination related to their ethnic background (Lopez & Stanton-Salazar, 2001). Further research should explore whether this result replicates and the factors that might contribute to this difference. Given the interest in measuring a broader array of children's academic skills and orientations in the early school years, these results are promising, yet the measure has room for improvement.

The child survey evaluated here extends previous work in this area in important ways. First, it was designed to assess PreK children's academic orientations whereas most prior published work focuses on kindergarten- and older-aged children. Prior work has shown some promise in using survey-style instruments for evaluating PreK children's relationships with teachers (Mantzicopoulos & Neuharth-Pritchett 2003; White, 2016), enjoyment (Arnold, Fisher, Doctoroff, & Dobbs, 2002; Arnold et al., 2012), learning goals (Chang & Burns, 2005; Day & Burns, 2011; Harris, Robinson, Chang, & Burns, 2007), and self-concept or competence (Stipek et al., 1995). However, many of the measures used in these studies involved more complicated procedures (e.g., the use of puppets or storytelling) than children simply responding to interview style questions, the latter of which is desirable for quick use in schools. Another strength of the present study is the breadth of academic orientations assessed in the instrument with just 12 survey items in total (sometimes considered the bare minimum number of items given four constructs). As we describe in the limitations section, a short measure such as ours has inherent drawbacks. However, being able to assess a broad array of children's academic orientations in a short amount of time is highly valuable when researchers' time with children is restricted.

This study is also strengthened by the fact that it draws on survey response data from a large, diverse sample of public PreK children (56% Latino, 18% African American, 10% Asian), a group of high interest in public policymaking in the U.S. This allowed for a more rigorous psychometric evaluation, including invariance testing, which requires non-trivial sample sizes of children in different groups to determine whether the constructs are measured similarly among children in these groups. Once established, strong measurement invariance permits for an evaluation of mean differences across the groups. To our knowledge, invariance testing has not been conducted in any of the studies we have reviewed. We primarily found mean differences between boys and girls such that girls had more positive feelings about their teachers but lower levels of growth mindset. Children whose home language was Spanish had lower levels of school enjoyment than children whose home language was other than Spanish. These differences are important to track and in future work can be examined in relation to other school outcomes. It is difficult to compare the results of our analyses with prior studies as this type of rigorous psychometric work is rarely done or reported on with children of this age group (c.f., Guay et al., 2010; Zijlstra et al., 2013 for rigorous evaluations of measures used with 1st grade and older children). For example, the mean differences reported in Mantzicopoulos and Neuharth-Pritchett (2003) suggesting boys perceived more conflictual relationships with teachers is consistent with what we found, however the measured constructs are different and Mantzicopoulos and Neuharth-Pritchett (2003) did not report on measurement invariance. As a result, the mean differences they observed on boys' and girls' scale scores may reflect differential responding to the conflict items or may be true mean differences, making comparison with our results challenging.

6.1. Limitations and future directions

Although we found favorable measurement properties of our scales both in terms of indices of model fit (CFI, TLI, RMSEA) and low cross-loadings in the ESEM results, evidence from the response distributions of the items and the thresholds suggest that many children chose the highest response category for each item. On average, it was chosen 64% of the time by children on these survey items. From a measurement perspective this may be problematic because we are not able to differentiate children who are extremely high on the ability distribution on the latent trait from those whose ability is above average on the latent trait distribution. A future direction of this work would be to create items with higher threshold parameters or fewer children choosing the highest response category. This could be done by introducing additional items into the pool and field testing them with children or by trying to understand why so many children chose the highest response category. It may also be done by altering the visuals of the response scale by, for example, placing them on a logarithmic scale so the difference between categories is magnified. Similarly, additional response options could be included. However, researchers frequently observe that very young children tend to choose responses at the extremes of Likert scales (Chambers & Johnston, 2002; Mellor & Moore, 2013). This may help to explain the fact that, on average,

just 13% of children endorsed the middle category of our survey items.

Related to the fact that the predominantly Latino and non-White low-income public PreK children in this sample tended to respond to these items by choosing the highest category (64% on average), the maximal utility of the scale may be with similar samples. Higher-income children might be even more inclined to choose the highest category than the students in our sample, in which case the scale would provide little information about the full range of their academic orientations. Without data on these children, we cannot refute that possibility. However, were we to use this scale in such a sample we would consider many of the solutions raised in the preceding paragraph to try to ensure more spread in children's responses.

Correlations across child and teacher reports were modest at best and in line with what others have found with similarly-aged children (e.g., Mantzicopoulos & Neuharth-Pritchett, 2003; Papadopoulou & Gregoriadis, 2017; Poulou, 2017), providing some evidence of convergent validity of the child-reported scales. The feelings about teacher scale stood out for being significantly correlated with all teacher-reported scales. This can be interpreted in one of two ways. Children who have positive feelings about their teacher may elicit teacher ratings that are more positive in nature. Or, teachers' positive perceptions of the child might elicit more favorable behaviors toward the child, including more favorable ratings of the child in general. Some evidence for discriminant validity was found in our study, specifically as it concerned the dimension of conflict, which was negatively correlated with feelings about the teacher, school enjoyment, and growth mindset. However, although statistically significant, these correlations were small to moderate at best suggesting that there may be other unmeasured constructs that may serve as better indicators of discriminant validity for our task. Due to time constraints in the administration of these tasks, we were not able to include additional measures that may have served as stronger indicators of discriminant validity. The size of the latent correlations should also be interpreted in light of the fact that we did not measure the exact same constructs across reporters but rather only conceptually-similar constructs (e.g., teacher-reported closeness to the child and children's perceptions of their feelings about the teacher). This is because the larger study from which we drew this data was not designed to validate the child survey measure but instead to study classroom effects on children's academic development. Even with more closely-aligned measures it is unclear what the expected magnitude of the correlations should be given how young the child reporters were.

The reliabilities of our scales were just at or below the 0.70 level typically deemed appropriate for measurement development work (Nunnally & Bernstein, 1978). This is a common tradeoff with instruments that employ a small number of items to measure a broad range of constructs. As a result, we estimated ordinal omega reliability coefficients (Viladrich et al., 2017) that are appropriate when item response data is modeled within a latent variable framework (i.e., structural equation modeling) using estimators for ordinal data (e.g., WLSMV, maximum likelihood, or Bayesian estimation). Though our ordinal omega coefficients are slightly below what is typically accepted, we have provided evidence of multidimensionality of our scales, including unidimensionality within the scale (Clark & Watson, 1995), which highlights evidence of validity believed to be as important (or more) than high internal consistency. Typical approaches in applied research such as taking the mean of the items in the scale for use as a regression predictor or outcome are *not appropriate with these scales*. Nor should the mean of the items be used as a point estimate of a child's motivation or academic beliefs. These scales are only appropriate for research purposes.

Because these data were collected as part of a larger longitudinal study, we can administer the surveys to these same children on a yearly basis. Before doing so, we are further improving the items and scales, illustrating an ideal process of integrating rigorous psychometric work with current data collection efforts. Measurement work is typically done post hoc to give more credence to findings of a study. Rarely do researchers have the opportunity in practice to iterate on measurement development while data are still being collected. In response to findings form this study, we have added an additional item per scale, bringing each scale's total item count to four. Our highest priority is improving the feelings about teacher scale, in which the correlation matrix, ESEM, and IFA results indicated that the first item ("How much does your teacher care about you?") did not perform well. Reasons for this are varied, but possibilities include that children in this sample did not understand the term "care," or that they do not associate the term care with their teacher. The two items referencing liking the teacher and being liked by the teacher were highly correlated, and therefore did not likely provide different information about the teacher feelings construct. We will keep one of these and develop three new items for the scale. The other scale we are focused on is the growth mindset scale, which uses a picture prompt that the survey items refer to. Because our goal was to create a very brief measure, the same image of a complicated wood block castle is used across items, and we chose this image based on two key factors. First, that block play is a domain-general preschool activity (e.g. has been linked to both math-related and language-related skills, as well as social-emotional and motor skills across numerous studies), and second, blocks are the most common material found in early childhood classrooms, only behind books (see Bassock, Latham, & Rorem, 2016). The mindset items rely on providing a challenging problem, and we must ensure that the picture prompt remains challenging as children age and their problem-solving abilities increase.

Evaluating the psychometric properties of a scale is an ongoing process (Clark & Watson, 1995). As we have described above, this paper presents the first iteration of an ongoing process to create valid and reliable measures of young children's academic orientations. We started the process while children were in preschool and will be iterating and collecting data on these children as they progress through the first four years of formal schooling. Even though the sample of children remains the same throughout this process, developmental differences as they age are important to consider when administering these items. Although what we have presented in this article is a ready-to-use off-the-shelf set of scales regarding children's academic orientations, we urge researchers to undergo a similar process of investigating the factor structure, internal reliability, and convergent validity after administering these items to other samples of children, particularly samples that differ demographically and socioeconomically from the one here.

7. Conclusion

Early childhood education is becoming a more common experience for children as well as a growing educational focus. The quality of this education determines the benefit it has on a child, and it is important to be able to identify what factors relate to quality programs, and to measure the benefits of programs across different types of outcomes. In this article we argue that children's perceptions of their educational experience – their ideas about themselves as learners (perceived academic competence, mindset) and of their learning environment (enjoyment, teacher–student relationship) – are important considerations when assessing the impacts that early childhood education can have, as well as helping to understand key developmental processes related to education, an area in which strong research only exists for older children. Assessment

in school settings is a challenge, and directly assessing young children's perceptions is even more challenging given their somewhat limited capacity for communication and self-reflection. Our goal was to develop a short survey-style measure at the level needed for young children that would be appropriate for school-based assessment. Evaluating a newly-developed set of measures of children's academic orientations using rigorous psychometric methods, we found adequate validity for the multidimensionality of our scale, separation of constructs as evidenced by the low cross loadings of items, and some evidence for convergent validity using less than ideal measures (teacher reports). Given the findings of our study and the fact that this data comes from an ongoing project, we will continue to improve upon these measures by increasing the number of items for each scale to four and creating new items for the feelings about the teacher scale.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.ecresq.2018.10.012.

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