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Schachter, Rachel E.; Spear, Caitlin F.; Piasta, Shayne B.; Justice, Laura M.; and Logan, Jessica A.R., "Early childhood educators' knowledge, beliefs, education, experiences, and children's language- and literacy-learning opportunities: What is the connection?" (2016). *Faculty Publications, Department of Child, Youth, and Family Studies*. 238.

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Early childhood educators' knowledge, beliefs, education, experiences, and children's language- and literacy-learning opportunities: What is the connection?

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Abstract

In this study, we investigated how multiple types of knowledge and beliefs, along with holding an early childhood-related degree and teaching experience, were linked to amounts of early childhood educators' language and literacy instruction. Quantile regression was used to estimate associations between these variables along a continuum of language and literacy instruction for 222 early childhood educators. In general, low levels of language- and literacy-related instruction were observed; however, the use of quantile regression afforded unique insight into the associations of knowledge, beliefs, education, and teaching experience with instruction when levels of instruction were sufficient. These findings would not have been visible with traditional, linear regression models. Specifically, two types of knowledge were examined: disciplinary-related content knowledge about the structure of language and knowledge for use in teaching language and literacy to young children.

Published in *Early Childhood Research Quarterly* 36 (2016), pp 281–294.

doi 10.1016/j.ecresq.2016.01.008

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Submitted 21 September 2015; revised 4 January 2016; accepted 16 January 2016;

published 1 February 2016.

Only educators' disciplinary content knowledge was associated with amount of instruction. Associations between beliefs about language and literacy instruction and amount of instruction were less consistent. Generally, holding an early childhood related degree was positively associated with language and literacy instruction whereas teaching experience was negatively associated with the amount of instruction. Implications for studying educators and understanding the associations among educator characteristics and instruction are discussed.

Keywords: Language and literacy instruction, Knowledge, Beliefs, Experience, Educators

1. Introduction

A wealth of knowledge exists concerning young children's development of language and literacy skills and the importance of these skills for success in formal school settings (National Early Literacy Panel, 2008; NICHD Early Child Care Research Network, 2005; Storch & Whitehurst, 2002). This research has led to a growing knowledge base about the type of language- and literacy-learning experiences young children need in order to develop these skills (Bowman, Donovan, & Burns, 2001; National Association for the Education of Young Children [NAEYC], 2009; Snow, Burns, & Griffin, 1998). However, evidence also suggests that early childhood educators do not always provide the types of instruction necessary to ensure the development of children's skills. Researchers have examined language and literacy instruction in early childhood settings in a variety of ways including: rating the language interactions between educators and children (Justice, Mashburn, Hamre, & Pianta, 2008; Pianta, La Paro, & Hamre, 2008), measuring the classroom literacy environment (Early et al., 2007), or calculating the amount of time spent in language and literacy instruction (Fuligni, Howes, Huang, Hong, & Lara-Cinisomo, 2012; Pelatti, Piasta, Justice, & O'Connell, 2014; Sandvik, van Daal, & Adèr, 2014). Regardless of approach, in general, the quality and quantity of educators' language and literacy instruction have been less than optimal.

One response to research showing lower quality and quantity of instruction in early childhood settings has been to learn more about characteristics of educators to gain insights as to how to improve instruction. Specifically, educators' knowledge and beliefs are theoretically linked with instruction, and both have been empirically examined in efforts to understand more about how these contribute to

instruction. In addition, educators' education and teaching experiences are often considered as contributing to the development of knowledge and beliefs and, thus, are also frequently studied as these relate to instruction. Learning more about these associations is important, as knowledge, beliefs, education, and teaching experience are malleable aspects of educator preparation and training on which we can "intervene" in efforts to shift instruction to improve children's outcomes. These investigations, however, have not always clearly illuminated the connections between educators' characteristics and instruction. When taken as a whole, the equivocal findings across this body of work leave important gaps in the literature for those interested in improving instruction. Thus, the purpose of the present study was to further examine the associations of knowledge, beliefs, education, and experience with instruction in order to expand our understanding of the complex ways in which these might be linked to the language and literacy instruction that educators provide.

1.1. Knowledge

Educator knowledge is theorized to be related to classroom instruction and subsequent child outcomes (Grossman, 1990; NAEYC, 2009; Shulman, 1987; Wasik & Hindman, 2011). Knowledge is important for teaching because educators could use information to make instructional decisions in their classrooms (Lampert, 2001; Turner-Bisset, 1999). Knowledge is a multifaceted construct, and theorists and researchers have identified and examined many types of knowledge that may be related to instruction (Ben-Peretz, 2011; Borko and Putnam, 1995; Clandinin and Connelly, 1988; Shulman, 1987). In particular, early childhood researchers have examined multiple types of educators' knowledge, including disciplinary content knowledge (Cunningham, Zibulsky, & Callahan, 2009), conceptual and procedural knowledge of language and literacy (Hindman and Wasik, 2011), and knowledge that educators "use in [for] practice" (Neuman & Cunningham, 2009, p. 544). Researchers have also examined pedagogical content knowledge (Shulman, 1987) in terms of educators' reports of their knowledge of strategies for teaching phonological awareness and vocabulary, and found that such knowledge tended to reflect incomplete understandings of how children develop those skills (O'Leary, Cockburn, Powell, & Diamond, 2010). When measuring these different

types of knowledge, each research team used their own measures and, across the board, educators generally scored low on these measures of knowledge.

Researchers have also examined how these different types of educator knowledge are associated with instruction. For example, Piasta, Connor, Fishman, and Morrison (2009) examined educators' knowledge of English language and literacy, assessing educators' disciplinary content knowledge or knowledge about the content they were teaching. They found that higher disciplinary knowledge predicted children's literacy outcomes when examined in combination with time in decoding instruction. Thus they linked educators' disciplinary content knowledge with their instruction. In contrast, Cash, Cabell, Hamre, DeCoster, and Pianta (2015) examined a different type of knowledge, looking at educators' understanding of children's skill development within specific language and literacy developmental domains. Although they measured a variety of child outcomes, they found that educators' knowledge only predicted gains in children's expressive vocabulary and print knowledge. Implicit in their findings is the notion that knowledge informs instruction which can then be linked to children's learning. Both of these findings about knowledge, however, are specific to the types of knowledge measured.

These findings regarding the associations between knowledge and instruction are difficult to disentangle given the multiple ways that knowledge is assessed and are further complicated by a lack of understanding about the ways changes in knowledge contribute to changes in educators' instruction. One of the most common mechanisms for affecting this change is the use of professional development (PD) models; however, recent research indicates that even when PD models have been successful in changing educators' scores on measures of knowledge used for practice (Neuman and Cunningham, 2009) or disciplinary content knowledge (Carlisle, Correnti, Phelps, & Zeng, 2009), there are not necessarily changes in educators' instruction. In these cases the associations between new knowledge and instruction are unclear. Moreover, sometimes changes in educators' knowledge does not result in improved outcomes for children (Cunningham et al., 2009; Gerde, Duke, Moses, Spybrook, & Shedd, 2014), suggesting that the type of knowledge measured, in these cases disciplinary content knowledge and "knowledge of emergent literacy" (p. 427), may not always be linked to language and literacy instruction.

1.2. Beliefs

Researchers have also theorized that educators' beliefs are related to instruction (Nespor, 1987; Pajares, 1992) and that what educators believe impacts what they do in the classroom (Clark and Peterson, 1984; Guskey, 2002). Included in the conception of beliefs are educators' values and assumptions (Evans, Fox, Cremaso, & McKinnon, 2004; Fenstermacher, 1994) and some have argued that beliefs are interrelated with knowledge (Hindman and Wasik, 2008). Like knowledge, this somewhat nebulous concept has been measured in a variety of ways by early childhood researchers, with mixed findings as to whether or not educators' beliefs are associated with instruction in empirical studies.

Although educators tend to report beliefs that support research-based recommendations for language and literacy instruction (Han & Neuharth-Pritchett, 2010; Hindman & Wasik, 2008), how these beliefs are connected to educators' enacted instruction is less clear. For example, Sandvik et al. (2014) found that educators' reported beliefs aligned with current research, yet educators' reported instruction was not consistent with these beliefs. In other words, educators reported spending very little time in high quality language and literacy instruction in contrast to their reported beliefs both about how children develop skills and their roles as educators in that process. Conversely, other research indicates that educators' beliefs seem to match observable instruction related to educator-child interactions (McMullen et al., 2006). There is also emerging research demonstrating no associations between educators' beliefs and outcomes for children. Cash et al. (2015) measured educators' beliefs about language- and literacy-related skills children need as they enter preschool and found that these beliefs were not connected with children's scores. They suggest that, at least based on their data, educator knowledge is more important for instruction than beliefs. Finally, similar equivocal patterns are present in the PD research, which has found mixed results in the malleability of beliefs and instruction. Some efforts have led to changes in beliefs and instruction (Hamre et al., 2012) whereas others have not found these co-occurring changes (Breffni, 2011).

1.3. Education and experience

Education and previous teaching experiences can be seen as proxies for knowledge and beliefs as these experiences may contribute, directly or indirectly, to the development of these constructs. Although the nature of these associations is difficult to disentangle, there is evidence of the influence of these background experiences on knowledge and beliefs (Berliner, 1986; Han & Neuharth-Pritchett, 2010; Jung & Jin, 2014; Nelson, 2015). For example, Hindman and Wasik (2011) found that educators' procedural and conceptual knowledge about language and literacy instruction was higher when they had more years of education. Jung and Jin (2014) found that early childhood-specific coursework mediated educators' perspectives about play-based instruction and increased their intended use of the practice, thus indicating that education could shift educators' beliefs.

Despite the potential role of education in contributing to the development of knowledge and beliefs, there are equivocal findings in the literature about the associations between education and instruction. In results from correlational studies, early childhood educators' degree attainment has both been linked to overall better classroom instruction (Barnett, 1995; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Reynolds, Temple, Robertson, & Mann, 2002) and found to have no association with general instruction (Early et al., 2007; Vu, Jeon, & Howes, 2008) or with the quality of classroom interactions (Fuligni, Howes, Lara-Cinisomo, & Karoly, 2009). Interestingly, when educators hold degrees directly related to working with young children, degree is positively associated with language and literacy instruction (Gerde and Powell, 2009; Pianta et al., 2005). For example, Gerde and Powell (2009) found that educators with early childhood-related degrees engaged in more book reading practices than educators without degrees. Thus it seems that early childhood specific coursework and resulting degrees may contribute to language and literacy instruction.

Similarly, there is much work examining teaching experience and instruction in both the early childhood and K-12 literature bases. Here again the research is mixed about the connection between years of teaching experience and instruction. There is evidence that teaching experience improves instruction generally (Berliner, 1986; National

Institute of Child Health Human Development Early Child Care Research Network, 2000; Rivkin, Hanushek, & Kain, 2005), yet other researchers have found that teaching experience is only minimally associated with instruction (Guarino, Hamilton, Lockwood, & Rathbun, 2006; Nye, Konstantopoulos, & Hedges, 2004). Typically research shows that educators' practice improves until around the fifth year of teaching and then plateaus (Palmer, Stough, Burdenski, & Gonzales, 2005; Rivkin et al., 2005), with additional declines over time. Research examining links between teaching experience and language and literacy instruction is less prevalent. However, in a study focused on early childhood language and literacy degree, Spear-Swerling and Zibulsky (2014) found that more years of teaching experience was related to fewer planned oral-language related activities as well as more educator-directed instruction suggesting possible associations between teaching experience and language and literacy instruction.

1.4. Equivocal state of the literature

In sum, there is mixed evidence about the associations between language and literacy instruction and educator knowledge, beliefs, education, and teaching experience—characteristics commonly examined and targeted by researchers as malleable aspects of educators' preparation and PD. Other researchers have also asserted that the interaction between knowledge and beliefs to inform instruction is complex and less clearly understood (Pianta et al., 2014). This gap in our current understanding is particularly important as those interested in improving outcomes for children seek ways to assist educators in improving instruction. Next possible explanations for these mixed findings are discussed.

One difficulty with the knowledge and beliefs literature may be related to the samples used to examine these educator characteristics. Many of these studies included relatively small sample sizes. For instance, in an examination of educator beliefs, Han and Neuharth-Pritchett (2010) had only 26 educators. Similarly, Cunningham et al. (2009) included only 20 participants in their examination of knowledge. These samples can also be limited in that they are specific to one particular population, such as Hindman and Wasik (2008) or O'Leary et al. (2010), who only examined Head Start educators. Their findings

may not be representative of educators as a whole. Thus, it is important to broaden the field's understanding of educators' knowledge and beliefs through the use of larger, more diverse samples.

Another possible explanation for the equivocal findings may be that almost every study used a unique measure to access knowledge and beliefs. This is in part due to the inherent complexity of the constructs being measured, including the multiple types of knowledge that can and have been measured (Ben-Peretz, 2011) and the different methods have been used to access beliefs (Pajares, 1992; Wen, Elicker, & McMullen, 2011). This has resulted in an inability to make comparisons across studies or compile enough evidence to draw conclusions about the role of educator knowledge and beliefs in relation to instruction. In order to better understand these associations, more research is needed that uses comparable measures of knowledge and beliefs.

In addition, there may also be statistical limitations that contribute to these findings. The use of small samples sizes decreases statistical power, thereby limiting the ability to detect statistically significant associations. In addition, the majority of the studies examining educators' knowledge and beliefs use basic descriptive analyses, which do not allow for any claims to be made regarding associations. Those studies that move beyond basic descriptive analysis often rely on traditional inferential statistics, such as linear regression analysis, which require the dependent variable to be normally distributed (Petscher and Logan, 2014) which may not be the case for instruction. In addition, these inferential statistics estimate average relations and therefore do not address variability across the distribution of the sample. It may be that knowledge and beliefs have differential associations with varying levels of instruction; however, these associations are masked when comparisons are made at the mean of the constructs. In other words, we hypothesized that based on the extant findings, educator characteristics may not be predictive for all levels of instruction but only be associated at the ends of instruction. For example, it may be that given the plateau in instruction around five years of teaching experience, teaching experience may only be associated with lower levels of instruction. Thus, it is important to broaden the literature by examining the associations of educator knowledge and beliefs with instruction using viable statistical approaches that allow for variability in these constructs and their associations.

1.5. Present study

This study seeks to address several of the issues highlighted above by extending traditional examinations of educator characteristics using a variety of established measures to a larger, more diverse sample, and then investigating the associations of these characteristics with instruction. More specifically, the first research aim was to use a larger dataset and multiple measures to characterize educators' knowledge and beliefs about language and literacy instruction using measures previously developed and used by other researchers, rather than study-specific measures. The second aim of this study was to extend the literature by examining the extent to which educators' knowledge and beliefs about language and literacy instruction, along with their education and teaching experience, predicted their provision of language and literacy instruction. We intentionally selected multiple measures of knowledge and clearly aligned the beliefs and instruction measures in order to examine the complexity of these constructs. In addition, we hypothesized that the varied findings of previous research are in part due to the differential importance of predictors for educators with varying levels instruction. Therefore the relations between constructs were examined using quantile regression (Buchinsky, 1998; Koenker, 2005; Petscher and Logan, 2014), which allowed us to determine whether associations between these constructs varied along a continuum of instruction.

2. Method

Data for the current study were collected as part of a larger evaluation of a statewide PD experienced by early childhood educators across a Midwestern state. For the larger study, participants had to be teaching in a classroom with four year old children and agree to participate in all of the study activities. In addition, up to five children were randomly selected from each educator's classroom for participation in the study.

2.1. Participants

Two hundred twenty-two early childhood educators (one per classroom) from the first two cohorts of the larger study participated. Most participants were female (96%) and identified as White/Non-Hispanic (80%); 19% identified as African American, and less than 1% identified as Asian American and “Other.” Educators’ ages ranged from 23 to 69 years old, with an average of 41.28 years ($SD = 10.49$). Participants’ early childhood teaching experience ranged from 0 to 36 years, with an average of 11.02 years ($SD = 7.31$). Sixty-one percent ($n = 131$) of educators held a bachelor’s degree or higher, whereas 23% ($n = 49$) held an associate’s degree, and 10% ($n = 22$) held a high school diploma as the highest degree earned. Of the participants 60% ($n = 134$) held an early childhood-related degree. Participants’ classrooms were in rural (33%, $n = 74$), suburban (26%, $n = 57$), and urban (25%, $n = 56$) locations (16%, $n = 35$ unreported). The majority of educators (85%, $n = 189$) taught in publicly-supported programs; the rest were in programs supported by private tuition. Almost 50% of participants were affiliated with Head Start ($n = 110$) as it funds the majority of public programs in the state, 47% ($n = 110$) were affiliated with public school programs, 14% ($n = 32$) received other federal support, and 14% ($n = 30$) were affiliated with non-profit organizations such as the YMCA or the United Way. Notably, as many programs combined funding totals do not add up to 100%. The children in these programs were, on average, 56 months old ($SD = 4.96$ months; Range = 39–78 months, $n = 785$). Most of the children were White/Caucasian (74%), 22% were Black/African American, and 3% identified as “Other,” and 1% did not report race. Six percent were described as Hispanic or Latino by their caregivers. Generally, educators reported using some type of curriculum, with 80% ($n = 178$) reporting using a global curriculum such as *Creative Curriculum* or *High/Scope*; in addition 19% used a literacy-specific curriculum such as *Let’s Start with Letter People*. This diverse sample of educators was fairly representative of the typical variability of early childhood educators and settings when compared to national reports with slightly higher numbers of Head Start and BA-level educators (Clifford et al., 2005; Institute of Medicine and National Research Council, 2012).

2.2. Procedures

Data were collected from educators who consented to participate in the larger PD evaluation. This study used a subset of measures from the larger study, collected in the fall assessment periods (September to December of 2011 and 2012). Surveys, completed by educators independently, were used to examine a range of educator variables including knowledge, beliefs, education, and teaching experience. Educators were given surveys at the start of the fall assessment period and were required to return completed questionnaires by the end of that period. Videotaped classroom observations were also conducted and coded for the amount and type of literacy instruction provided by each educator. Specific measures are described in detail below.

Classroom observations were conducted by trained field assessors who observed and videotaped each classroom on a fall day selected by educators as representative of typical classroom instruction. Although all classroom instruction was recorded, there was a range in observation length from approximately 24 min to almost 300 min ($M = 98.17$, $SD = 29.14$, see **Table 1**). This variability was due to differences in the length of programs (e.g., half- versus full-day programs) and the amount of instructional time educators reported scheduling, and is consistent with patterns in the literature base that instructional time within classrooms is highly variable depending on context (Early et al., 2010).

Table 1. Minutes of instruction overall and by type of language and literacy instruction across quantiles as well as the observed minimum and maximum.

<i>Type of instruction</i>	<i>Minimum</i>	<i>.10 quantile</i>	<i>.25 quantile</i>	<i>.50 quantile</i>	<i>.75 quantile</i>	<i>.90 quantile</i>	<i>Maximum</i>
Observation length	23.24	64.72	77.00	97.47	113.15	135.55	219.99
Code	0.00	0.00	0.72	3.94	5.79	10.02	24.85
Oral Language and Vocabulary	0.00	0.21	1.03	3.90	5.72	8.38	22.15
Reading	0.00	0.44	3.30	8.34	12.00	17.86	35.12
Writing	0.00	0.00	0.00	1.29	1.46	3.93	17.76

2.2.1. Education and teaching experience measures

Information about educators' education and teaching experiences was collected through the fall survey. The present study used only information from the demographics section, which contained questions about educator age, gender, race, education, training, and program in order to provide the descriptive information about participants described above. We also identified whether educators held an early childhood-related degree and the numbers of years they had been teaching. The early childhood degree variable was a dichotomous variable that included any educators who indicated they had a Bachelor's degree or higher in an early childhood-related area or that they had an early childhood-specific certification (i.e., CDA). Notably, holding an early childhood degree is a construct distinct from highest level of education ($r(222) = .06, p < .05$) and only the former was investigated in the present study, given evidence that when educators hold degrees directly related to working with young children, education is positively associated with language and literacy instruction (Gerde and Powell, 2009; Pianta et al., 2005).

2.2.2. Knowledge measures

Educators' knowledge about language and literacy was assessed using two different established measures in order to both capture different types of knowledge and extend the extant literature. These were the *Teacher Knowledge Assessment of Early Language and Literacy Development* (Neuman and Cunningham, 2009) and the *Teacher Knowledge Assessment* (Cunningham et al., 2009). We selected these measures because they focus on two distinct types of theoretically important knowledge (i.e., knowledge for use in practice and disciplinary content knowledge) emphasized throughout the literature (Piastra et al., 2009; Shulman, 1987) and access different types of knowledge needed for language and literacy instruction.

2.2.2.1. Knowledge for use. The *Teacher Knowledge Assessment of Early Language and Literacy Development* measure is described by its authors as a measure of knowledge that would be used to enact instruction; as such we refer to it as the Knowledge for Use measure. This measure consisted of 70 items (50 multiple choice and 20 true-false questions) combined into a total possible score of 70. This measure

targeted educators' knowledge of a range of language and literacy types (e.g., phonological awareness, oral language comprehension instruction, assessment), general child development, and how to use this knowledge to provide instruction. Sample items include: "During group time, Ms. Betty is about to read a book to her 5-year-olds. As she reads, she runs her finger along underneath the text. Why does she do this?" or "T/F—Block areas generate large amounts of child communication." The Knowledge for Use measure had strong internal consistency ($\alpha = .96$) in the literature (Neuman and Cunningham, 2009) and adequate consistency ($\alpha = .73$) in the current study.

2.2.2.2. Content knowledge. The *Teacher Knowledge Assessment* is designed to assess disciplinary content knowledge about "spoken and written language structures" (p. 498; Cunningham et al., 2009) which are critical to the teaching of reading; as such we refer to it as the Content Knowledge measure. The Content Knowledge measure consisted of eight multiple choice or short-answer items, six with additional sub-questions, combined into a total possible score of 19. It assessed educators' knowledge of phonology, morphology, orthography, and word recognition. Sample items include: "Does the word scratch contain a consonant blend?" or "Count the number of phonemes you hear in the word though." Internal consistency with the study sample was adequate ($\alpha = .76$).

2.2.3. Beliefs measures

To examine educators' beliefs about language and literacy instruction we used the *Preschool Teacher Literacy Beliefs* measure (Hindman and Wasik, 2008; Seefeldt, 2004). We selected this measure as it has been used by other researchers and also provided the opportunity to look at subsets of beliefs as they aligned with four different types of language- and literacy-related instruction. The Beliefs measure consisted of 30 items targeting four language and literacy constructs and examined the degree to which educators' beliefs about language and literacy instruction matched with research-based evidence concerning how early literacy develops and can be appropriately supported in the classroom. The constructs were: (a) Code (e.g., "As a teacher I believe preschool children should learn to identify beginning and ending sounds in words."), (b) Oral Language and Vocabulary (e.g., "As a

teacher I believe preschool children should be taught to speak in complete sentences.”), (c) Reading (e.g., “As a teacher I believe preschool children should look at books to help them read.”), and (d) Writing (e.g., “As a teacher I believe preschool children learn to read before learning to write.”). Educators were asked to rate the degree to which they agreed or disagreed with various statements on a scale of 0 for strongly disagree to 4 for strongly agree and were given an average score for each subscale (e.g., Code). Consistency of specific subscales ranged from .60 to .73 in the literature, however the alphas for the study sample were lower (Code = .31; Oral language and vocabulary = .59; Reading = .35; Writing = .35). Although these are typically considered unacceptable levels, given the scaled nature and thus limited variance of the Beliefs measure, the alphas are expected to be less precise due to larger estimation errors and negative biases (Sheng and Sheng, 2012) and should be interpreted with caution.

2.2.4. Instruction measures

Although there are many ways of examining instruction in ECE classrooms, for the purposes of this study, we examined the amount of language- and literacy-related learning opportunities educators provided to children, similar to work by Fuligni et al. (2012), Pelatti et al. (2014), and Sandvik et al. (2014). Specifically, we used an adaptation of the Individualizing Student Instruction (ISI) classroom observation system (Connor, Morrison et al., 2009; Connor, Piasta et al., 2009), which captures the amount of instruction individual children experience across multiple content types. The present study used a version of ISI that was adapted to focus on language and literacy instruction provided in early childhood education settings (Pelatti et al., 2014).

Although the ISI coding system captures many dimensions of instruction, we were specifically interested in the language and literacy content provided by educators. The ISI content dimension targets twelve distinct types of language and literacy instruction reflective of research-based recommended instruction for early childhood language and literacy learning. For the current study, we created four composite scores of instruction that aligned with the four constructs in the Belief measures. These were (a) Code, (b) Oral Language and Vocabulary, (c) Reading, and (d) Writing. The Code composite included six codes that related to instruction targeting emergent skills related to

later decoding (e.g., alphabet knowledge, phonological awareness); the Oral Language and Vocabulary composite included two codes capturing oral and written language and vocabulary development; the Reading composite was made up of three codes that captured emergent reading, shared reading, and comprehension instruction; and Writing consisted of the one writing code. Appendix A provides a full listing of ISI content codes by construct.

Classroom observation videos were coded with the ISI coding system in a research lab by trained coders using Noldus Observer Pro software (Noldus Information Technology, 2009). Following standard ISI procedures, instruction was coded at the individual child level for up to five children per classroom. For the purposes of this study, aggregate scores of individual child experiences were used to represent overall classroom-level instruction, similar to other research on instructional time in classrooms (Fuligni et al., 2012). The amount of instruction for each child in a classroom was averaged to obtain the mean amount of instruction that an educator provided across the classroom. Interrater reliability, as measured by one-way random single-measure intraclass correlation coefficients (ICCs) for 15% of randomly selected videos was .85 for Code, .73 for Oral Language and Vocabulary, .96 for Reading, and .71 for Writing, which all indicate good to excellent reliability (Cicchetti, 1994). See Pelatti et al. (2014) for more information on ISI observation and coding procedures.

In general, the time spent on language and literacy instruction across the four composites was quite low, although there was a range for each type of instruction (0–24.85 min for Code; 0–22.15 min for Oral Language and Vocabulary; 0 to 35.12 min for Reading; and 0 to 17.76 min for Writing). Table 1 presents the distribution of amount of instruction across the participants. For all four types of instruction, the data were non-normally distributed, demonstrating floor effects or extreme positive skew, as displayed in **Fig. 1**. This positive skew has been observed in other studies of instruction (Early et al., 2010; Justice et al., 2008; Weiland and Yoshikawa, 2013). On average, educators spent the most time in Reading instruction, with Writing exhibiting the least amount of instruction.

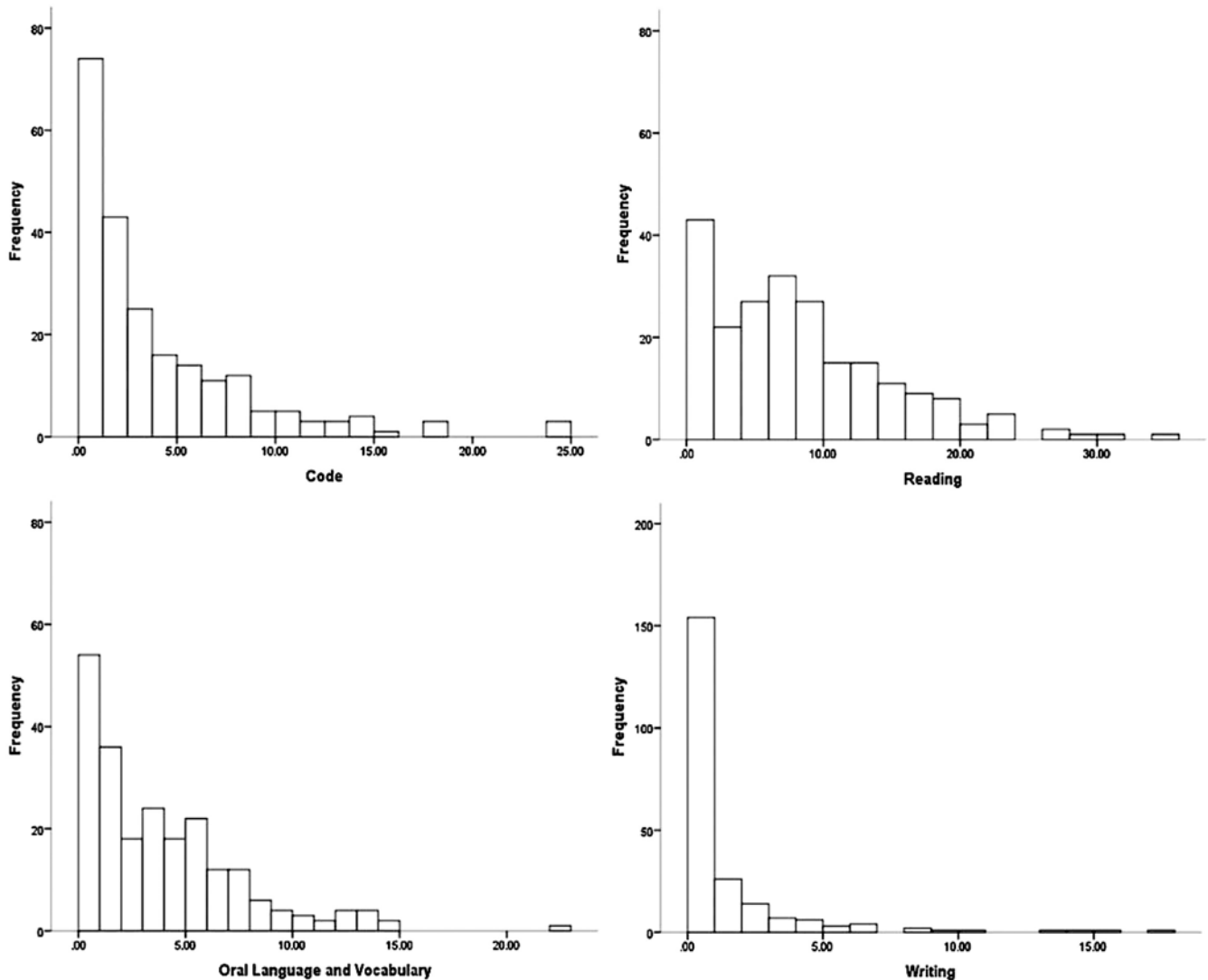


Fig. 1. Distribution of ISI instruction variables. All scales are the same except for ISI Writing, due to the large number of educators who scored at the floor on the Writing instruction variable.

2.3. Data analysis

The first step in the analysis was to examine the missing data. Approximately 10% of the cases had missing values. Educators' responses to the Content Knowledge measure had the highest level of missingness at 4.5% with the rest of the predictors missing less than 3% of responses. Results from the Little's MCAR test provided evidence that the data were missing completely at random ($\chi^2 = 39.537$, $df = 53$, $p = .915$). Given the low percentages of missingness and that the data

Table 2. Correlations among variables of interest (n = 222).

	1	2	3	4	5	6	7	8	9
Educator experiences									
1. Teaching experience	—								
2. Early childhood degree	.08	—							
Knowledge									
3. Knowledge in use	.07	.16*	—						
4. Content knowledge	.01	.13	.49**	—					
Beliefs									
5. Code	.10	-.02	.26**	.18**	—				
6. Oral language and vocabulary	.04	-.02	.24**	.21**	.42**	—			
7. Reading	.16*	-.06	.15*	.09	.23**	.50**	—		
8. Writing	.02	.12	.25**	.17*	.25**	.38**	.29**	—	
9. Observation length	-.03	.08	.17*	.20*	-.04	-.03	-.01	.08	—

* $p < .05$; ** $p < .01$

were missing completely at random, a single imputation was used to impute missing data for the independent variables used in the analysis (Tabachnick and Fidell, 2013).

Second, we ran bivariate correlations to assess the associations among our predictor variables as well as the overall duration of classroom observations (i.e., observation length; **Table 2**). Generally, the two measures of knowledge, and the four belief subscales were all significantly, moderately, and positively related to each other. Educators' holding of an early childhood degree was significantly associated with Knowledge for Use and teaching experience was significantly associated with beliefs about Reading. However, both of these correlations were small. The degrees of association were such that multicollinearity was not a concern, and we were able to include all predictors in subsequent models. Observation length was only significantly associated with Knowledge for Use.

Third, we computed the means and standard deviations of educators' scores on the knowledge and beliefs measures in order to address our first research aim. Fourth, we used R software and quantile regression (version 3.1.2; R Development Core Team, 2014; quantreg package) to address our second research aim. We selected quantile regression for use in analyses as it provides insight into whether or not predictors and outcomes are associated differentially at different points across the distribution of the outcome (Buchinsky, 1998; Koenker, 2005; Petscher and Logan, 2014).

Quantile regression allowed us to examine the association among measures of educator characteristics (predictors) and language and literacy instruction (outcome) at multiple points along the distribution of instruction and thereby elucidate whether associations were stronger at different points across the continuum of instruction. Quantile regression is an extension of conditional median modeling and can estimate the relations between a predictor (or predictors, X_s) and outcome (Y) at several points in the distribution of Y . In estimating the relation between X and Y , quantile regression uses a similar procedure to ordinary least squares regression wherein the absolute residuals are minimized. However, in quantile regression the residuals are minimized conditional on a given quantile within the distribution of Y . Importantly, the conditional estimates are not based on small groups, rather in solving for the values of weights assigned to X (betas) all data points are included even when fitting a single quantile, thus differentiating this analytic approach from other approaches such as stratified sampling. This is accomplished through bootstrapping, data re-sampling, and statistical inference to simultaneously estimate the relations between variables at several points in the distribution (Koenker, 2005).

The present study's data met all requirements for quantile regression analysis. There are no set sample size requirements for quantile regression, although typically larger samples are more reliable than smaller sizes (Petscher and Logan, 2014); the current sample size is consistent with or exceeds sample sizes used in other reports employing quantile regression (Language and Literacy Research Consortium, Pratt, & Logan, 2014; Purpura & Logan, 2015). Importantly, quantile regression makes no assumptions about the normality of the data and as such was also appropriate given the positive skew of most of our outcomes of interest (Buchinsky, 1998). However, there are recommendations in the literature suggesting that estimates are more unstable with extreme sample skew (Tarr, 2012) and, as we observed so little Writing even at the median of our sample (see Table 1), we excluded this type of instruction from further analyses. One data requirement is that predictor variables have a minimum of zero, thus the knowledge and beliefs measures as well as the length of observation scores were rescaled based on the lowest participant score, such that the minimum was zero. The interpretation of each regression coefficient is in reference to an educator scoring at the sample floor of the Knowledge for Use, Content Knowledge, specific Beliefs sub-measure, and the minimum observation length.

We ran three quantile regression models, one for each for Code, Oral Language and Vocabulary, and Reading. We included our five variables of interest as predictors (only the aligned Beliefs measure was included in a given model; e.g., Code beliefs was included as a predictor of code instruction) and also controlled for observation length. Every .10 quantile was estimated to examine how the associations varied across the distribution (Petscher and Logan, 2014). Thus the relation between the outcome and predictors was estimated at 9 different points in the distribution of Y (**Fig. 2**). Each estimated weight (beta) is reported along with a 95% confidence interval and the corresponding *p*-value for the significance test, testing whether the estimate is significantly different from zero. Because all estimates are compared

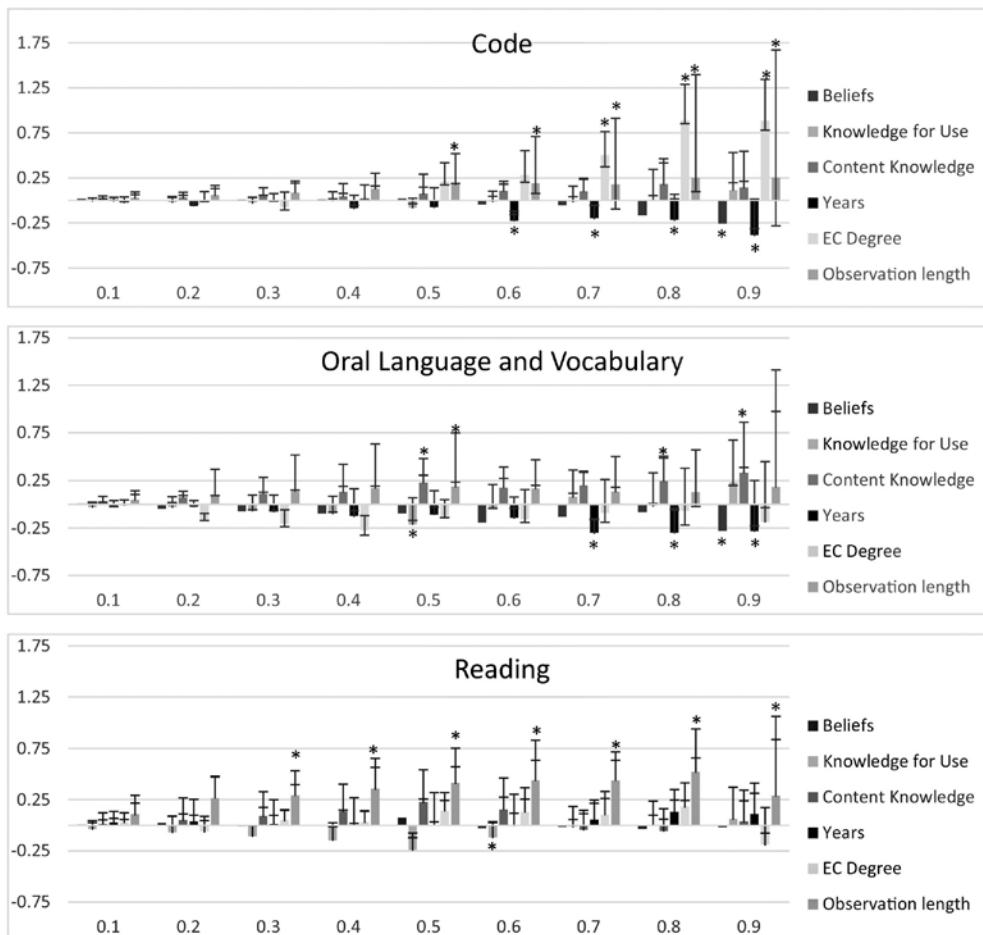


Fig. 2. Standardized estimates of the strength of the relations among each of the three given outcomes (Code, Oral language and Vocabulary, and Reading) as well as the control of observation, and each of the four predictors at every .10 quantile. Bands represent 95% confidence intervals.

to zero, and are calculated simultaneously through data re-sampling, we use the 95% confidence interval around each estimated relation (Koenker, 2005). In order to avoid Type 1 error associated with multiple hypothesis testing, any estimates with p -values close to .05 were interpreted with caution.

2.4. Results

2.4.1. Describing educators' knowledge and beliefs

Our first research aim was to characterize a broader sample of educators' scores on established measures of knowledge and beliefs. **Table 3** presents the means and standard deviations of educators' scores on these measures. Knowledge measure scores ranged from 21 to 60 for Knowledge for Use and 3 to 17 for Content Knowledge, indicating that there was large variability in educators' knowledge for use in instruction as well as in their disciplinary content knowledge. Notably, none of the educators were able to correctly answer all questions on either measure, with an overall average of about 65% correct on both measures. Educators reported a range in their agreement with statements about research-based strategies for developing children's language and literacy skills. Overall, scores on the beliefs measures indicated that educators held beliefs that were reflective of evidence-based instruction (averages ranging from 2.85 to 3.32, out of four). The scores were highest for beliefs about Writing and lowest for Code.

2.4.2. Associations of educators' knowledge, beliefs, education, and teaching experience with their instruction

The results for each outcome (Code, Oral Language and Vocabulary, and Reading) are presented in **Table 4**. Notably, the amounts and

Table 3. Mean (M) and standard deviation (SD) of educator scores on knowledge and beliefs measures ($n = 222$).

<i>Measure</i>	<i>M</i>	<i>SD</i>
Knowledge		
Knowledge in use	45.60	6.33
Content knowledge	12.52	3.10
Beliefs		
Code	2.65	.37
Oral language and vocabulary	3.22	.39
Reading	3.32	.42
Writing	3.31	.40

Table 4. Quantile regression estimates and standard errors for minutes of Code, Oral Language and Vocabulary, and Reading instruction (with unstandardized coefficients).

<i>Quantile and parameter</i>	<i>Code</i>	<i>Oral language and vocabulary</i>	<i>Reading</i>
.10			
Intercept	-.342(1.073)	-.030(1.256)	-.881(2.839)
Beliefs	.226(.664)	.104(.745)	.143(1.320)
Knowledge for use	-.004(.043)	-.018(.040)	-.040(.098)
Content knowledge	.015(.084)	.037(.082)	.027(.157)
EC degree	-.094(.459)	-.033(.525)	.179(1.076)
Teaching experience	-.004(.033)	-.007(.030)	.025(.066)
Observation length	.005(.010)	.006(.009)	.026(.021)
.25			
Intercept	.131(1.338)	.777(1.501)	.241(3.002)
Beliefs	.195(.814)	-.581(.868)	-.674(1.432)
Knowledge for use	-.025(.053)	-.019(.049)	-.069(.111)
Content knowledge	.077(.105)	.103(.102)	.179(.187)
EC degree	-.028(.566)	-.474(.640)	.111(1.175)
Teaching experience	-.039(.041)	-.025(.037)	.009(.077)
Observation length	.012(.012)	.015(.011)	.057(.025)*
.50			
Intercept	.401(1.627)	3.823(1.637)	-.381(3.251)
Beliefs	.273(.966)	-.919(.950)	1.183(1.651)
Knowledge for use	-.058(.064)	-.126(.059)*	-.252(.126)
Content knowledge	.113(.122)	.267(.116)*	.489(.240)*
EC degree	.967(.672)	-.521(.670)	.943(1.319)
Teaching experience	-.048(.046)	-.053(.042)	.004(.093)
Observation length	.030(.013)*	.024(.012)*	.099(.026)**
.75			
Intercept	1.338(1.756)	5.377(1.877)	2.679(3.232)
Beliefs	-.871(1.225)	-.962(1.059)	-.883(1.815)
Knowledge for Use	.016(.076)	-.004(.068)	.029(.127)
Content knowledge	.196(.144)	.260(.129)*	-.158(.265)
EC degree	3.192(.869)**	-.3.77(.755)	1.062(1.346)
Teaching experience	-.138(.050)**	-.133(.045)**	.105(.100)
Observation length	.031(.014)*	.008(.014)	.123(.024)**
.90			
Intercept	5.867(2.959)	5.123(2.533)	8.532(3.792)
Beliefs	-3.210(1.582)*	-2.649(1.190)*	-.321(1.999)
Knowledge for use	.084(.107)	.133(.090)	.067(.136)
Content knowledge	.212(.242)	.385(.167)*	.082(.320)
EC degree	4.103(1.346)*	-.672(1.123)	-1.257(1.742)
Teaching experience	-.244(.067)**	-.141(.068)*	.099(.112)
Observation length	.042(.017)*	.024(.024)	.069(.025)**

Beliefs measures were specific to instruction type, EC = early childhood; * $p < .05$; ** $p < .01$

variability of instruction appeared insufficient for detecting associations with predictors until the .50 quantile of instruction. In other words, for each language and literacy outcome, approximately 50% of the educators provided little or no instruction and therefore it was not possible to examine associations between predictor variables at those low levels of instruction. This is demonstrated in **Fig. 2** which presents standardized scores and confidence intervals for each model and each predictor across quantiles. It is also reflected in Table 4, which displays that intercept values are close to, if not actually, zero, depending on the outcome for the bottom 50% of the distributions. Examining associations using quantile regression made this pattern visible whereas other methods would have masked associations by computing an average association for the entire sample of educators including those exhibiting low occurrences of instruction. At the upper quantiles of the distribution, when educators were engaging in instruction, there were differential associations between types of instruction and our independent variables. Below, we highlight the significant associations detected for each of the three types of instruction.

2.4.2.1. Code. Starting at the .50 quantile, we found some associations between the predictors and amount of Code. Neither the Knowledge for Use nor the Content Knowledge scores predicted code instruction at any quantile. Beliefs about code instruction were negatively associated with instruction such that a score one point above the minimum on the Code beliefs subscale was associated with a decrease in about three minutes of Code at the .90 quantile. Holding an early childhood-related degree was associated with an increase in 2.5 and 4.8 min of Code for those educators in the .75 and .90 quantiles, respectively. Years of teaching experience was negatively associated with instruction at the .75 and .90 quantiles, such that at each quantile a 1 year increase in years of teaching experience was associated with greater decreases in amount of Code (0.14 and almost 0.25 min).

2.4.2.2. Oral language and vocabulary. Similar to Code, there were associations between our predictors and amount of Oral Language and Vocabulary. Knowledge for Use scores were negatively associated with Oral Language and Vocabulary at the .50 quantile, with a three point increase above the minimum score associated with a 1 min decrease in Oral Language and Vocabulary. This association, however, did not

continue across the quantiles. Content Knowledge was positively associated with instruction starting with the .75 quantile, such that for a four and then a three point increase above the minimum score on Content Knowledge was associated with an increase in approximately 1 min of Oral Language and Vocabulary. Beliefs about Oral Language and Vocabulary instruction were negatively associated with instruction at the .90 quantile such that a score one point above the minimum on Oral Language and Vocabulary subscale was associated with 2.6 min decrease in Oral Language and Vocabulary. Holding an early childhood-related degree was not associated with amount of Oral Language and Vocabulary. Similar to Code, years of teaching experience was negatively associated with amount of Oral Language and Vocabulary at the .75 and .90 quantiles, with each 1 year increase in teaching experience associated with small decreases in Oral Language and Vocabulary (.13 and .14 min).

2.4.2.3. Reading. None of our variables of interest predicted the amount of Reading. Although there was variability in the amount of instruction provided, there were no associations between instruction and knowledge, beliefs, education, or teaching experiences.

2.4.2.4. Summary. Although there were overall low levels of instruction, when language and literacy instruction did occur, we were able to determine associations between amount of instruction and our predictors. Knowledge for Use never predicted instruction. Content Knowledge positively predicted Oral Language and Vocabulary instruction only, starting at the .75 quantile. Educator beliefs were negatively predictive of instruction. Whether or not educators held an early childhood-related degree was only associated with Code. Finally, years of teaching experience were almost always negatively associated with amount of instruction.

3. Discussion

The goals of this study were to characterize early childhood educators' knowledge and beliefs using a range of pre-existing, established measures and to examine the extent to which the educators' knowledge and beliefs about language and literacy, along with education and

years of teaching experience, predicted their instruction. The use of quantile regression to examine associations between educator characteristics along a continuum of instruction is an important contribution of this study and addresses several limitations in the extant literature (e.g., limited samples, correlational analyses). In addition, the use of multiple pre-existing measures of knowledge and clearly aligned beliefs and instruction measures allowed us to examine the complexity of these constructs and their associations with each other. The additional benefit of using quantile regression was that it made visible the differential associations between our predictors of interest at varying levels of instruction. This type of analysis can help the field begin to unpack the mixed results regarding different types of knowledge, beliefs, and other educator characteristics and their associations with instruction.

In general, we observed very low levels of all types of language and literacy instruction. These low levels of practice were such that no associations between educator characteristics and instruction could be predicted until the .50 quantile. In other words, for participants who had minimal or no language and literacy instruction, it was not statistically possible to predict the association between instruction and educator characteristics. These floor effects, which have been found in other studies of the quantity of instruction (Pelatti et al., 2014; Sandvik et al., 2014) and were present for at least 50% of participants in each type of instruction, may contribute to the equivocal findings prevalent in the literature base. It may be that in studies with positively skewed instruction data, associations would be unlikely to be detected, whereas in studies where this was less of an issue associations were likely detected, thus, leading to differences in the extant literature. Indeed, other studies examining different types of instruction have also reported positively skewed data (Early et al., 2010; Justice et al., 2008; Weiland and Yoshikawa, 2013), however, they typically used analytic methods that would be unable to adequately deal with these floor effects, making it difficult to understand the association between educator characteristics and instruction—particularly for those sizable portions of the sample for which there was no measurable instruction.

When there was instruction to predict, we found variable associations among educators' knowledge, beliefs, education, teaching experience, and differing types of language and literacy instruction.

Generally, knowledge did not predict instruction, beliefs were negatively related, holding an early childhood-related degree was positively related to instruction, and years of teaching experience were negatively related. We found that these characteristics were differentially related to the types of language and literacy instruction, and that these did not predict reading-related instruction. Given the overall low levels of instruction, the ability to detect these associations is notable. Our regression coefficients reflect that our predictors of interest contributed in important ways to the amount of instruction. Moreover, these findings indicate that more nuance is needed in observing the associations between educator characteristics and instruction. This is important when considering which educator characteristics are related to which types of language and literacy instruction and can have important implications for those interested in improving the quality of language and literacy instruction. Next we discuss our findings and their implications for future research and professional learning.

3.1. Knowledge

Whereas there are multiple studies that examine specific types of knowledge in association with instruction, to our knowledge, this is the first study to examine multiple types of early childhood educator knowledge and instruction simultaneously. Our findings clarify the extant research by demonstrating that one specific type of knowledge was associated with a particular type of language and literacy instruction; a contrast that would not have been visible if we had just used one measure of knowledge.

Only our measure of Content Knowledge was predictive of instruction, and this was specific to Oral Language and Vocabulary. Educators with higher Content Knowledge had a 1 min increase in oral language and vocabulary instruction. Although this appears to be small, this 1 min increase in instruction is a 12–17% increase in the amount of oral language and vocabulary instruction that educators were providing. Given the low levels of overall instruction, this is not inconsequential. One possible interpretation for this finding is that educators with more disciplinary content knowledge have a better understanding of the importance of language and developing those skills in children. Thus they were providing more of this type of instruction. Interestingly, we found no associations between Content Knowledge and

code-focused instruction, which we had anticipated based the content targeted in the measure as well as previous research that has found associations between Content Knowledge and code-focused instruction (Piasta et al., 2009). More research regarding educators' content knowledge is needed.

Similar to Neuman & Cunningham (2009) who did not find associations between changes in Knowledge for Use and instruction for some participants, we found no association between this measure and any type of instruction. It may be that Knowledge for Use is not associated with instruction. This seems unlikely, however, given the need for educators' to be able to understand how to teach language and literacy content to their young learners (Shulman, 1987). Another possible explanation for the null findings related to both knowledge measures is that the construct of knowledge and how it is applied in the classroom is more challenging to assess. Other researchers have also found that it is difficult to link educators' knowledge to their instruction (Carlisle et al., 2009) or that knowledge is less strongly associated with instruction (Pianta et al., 2014). This could be related to the fact that knowledge is applied in specific classroom settings with individual children (Cohen, Raudenbush, & Ball, 2003; Lampert, 2001) and thus highly contextualized and therefore challenging to measure broadly. Some researchers have also observed that traditional survey measures are unable to capture the complexity of social interactions (Dickinson, Freiberg, & Barnes, 2011; Marshall and Rossman, 2010), which is how knowledge is enacted. This may also contribute to why our knowledge measures were less predictive of instruction. This study is an important first step in understanding how established measures are associated with a continuum of instruction. However, given our mixed findings, and the continued theoretical importance of knowledge when conceptualizing teaching and children's learning (Grossman, 1990; NAEYC, 2009; Wasik and Hindman, 2011), more research to understand the connections between knowledge and instruction is needed. It may be that more context-embedded methods, particularly ones that provide insight into the role of the environment and the children in shaping how knowledge is used for instruction, are needed.

Interestingly, with our larger, more inclusive sample we were able to confirm previous research that educators' scores on measures of knowledge, although variable, tend to be low across multiple types of

measures. Specifically, for both types of knowledge, Content Knowledge (Cunningham et al., 2009) and Knowledge for Use (Neuman and Cunningham, 2009), educators averaged 65% correct. This, along with previous research, suggests that there is room to improve educators' knowledge in both of these areas. Careful attention to the types of knowledge targeted in educator training programs, both pre- and in-service, may be necessary, especially as traditionally not much time is allocated for these learning opportunities (Neuman and Kamil, 2010). It may be that initial training efforts should target building content knowledge, but then educators may also need training and direct support on how to use that content knowledge for instruction (Carlisle et al., 2009). Our null findings suggest that additional support developing and applying multiple types of knowledge may be necessary to assist educators as they use developmental and content knowledge in their classroom language and literacy instruction.

3.2. Beliefs

In this study, our Beliefs subscales were specific to the type of instruction measured, thus affording the opportunity to look at differential associations between beliefs and specific types of instruction. New to this study is the examination of multiple types of instruction with specifically aligned belief constructs and, unlike other researchers (Breffni, 2011; Cash et al., 2015; Sandvik et al., 2014), we were able to demonstrate associations between these beliefs with instruction. These associations were highly mixed and depended on the type of language and literacy instruction observed. Yet, our findings add to the literature by empirically demonstrating associations between beliefs and multiple types of instruction. Specifically, there were negative associations between beliefs and both Oral Language and Vocabulary and Code (at least a decrease in 30% of the time spent in these types of instruction).

The negative associations between beliefs and Oral Language and Vocabulary and Code is an interesting and unexpected finding. It may be that there is a misalignment between these beliefs scales and our measure of instruction, although we designed the study such that these subscales closely aligned with our measures of instruction, so this explanation is less likely. An alternative explanation is that educators know how they are expected to answer questions like the ones

posed on the beliefs measure, exhibiting a type of social desirability effect (Phillips and Clancy, 1972), and their responses do not necessarily reflect their actual beliefs. This pattern is evident in the finding that, in general, participants reported beliefs aligned with research-based instruction, much like the findings reported by other researchers (Han & Neuharth-Pritchett, 2010; Hindman & Wasik, 2008). Similarly, it is possible that one can believe something without being able to put it into use. Indeed there is other research that has found that educators' reported beliefs do not necessarily align with their instruction (Sandvik et al., 2014). Thus, even though participants reported research-aligned beliefs, it may be that they were not able to translate these beliefs into meaningful instruction.

Whereas this study was able to demonstrate variable associations between beliefs and instruction along the distribution of instruction, there is still much that is unclear about these associations. More research may be needed to further explore if and how to "intervene" in relation to educators' beliefs. This need is further underscored by evidence that beliefs are difficult to change (Breffni, 2011; Pajares, 1992) and the mixed associations between beliefs and instruction (Cash et al., 2015; Hamre et al., 2012). Collectively, our findings and the extant literature highlight challenges and limitations in targeting educator beliefs, which may be more difficult to both understand and alter through PD. More research in this area is needed.

3.3. Education and teaching experience

The use of quantile regression helped to clarify some of the literature about associations of education and years of teaching experience with instruction. Specifically, we confirmed that holding an early childhood-related degree is positively associated with language and literacy instruction (Gerde and Powell, 2009; Pianta et al., 2005). Although there is differing evidence about degree and instruction (Barnett, 1995; Campbell et al., 2002; Early et al., 2007; Fuligni et al., 2009; Vu et al., 2008), degree type does seem to matter, at least as it relates to code-focused instruction. In fact, holding an early childhood-related degree predicted increases in the amount of Code by almost 50%. It could be that early childhood educator training programs focus more on this type of instruction, or that educators with early childhood degrees were able to access more recent research about code instruction.

Educators with early childhood training may have also learned more about how to provide direct code instruction for children and thus were able to enact more code instruction. More research is needed to fully understand these findings.

For all types of instruction except Reading, years of teaching experience was consistently negatively related to instruction. This negative association has been suggested in previous studies (Rivkin et al., 2005; Spear-Swerling and Zibulsky, 2014), but perhaps not quite so strongly, with a consistent 3% decrease in all types of instruction. It is interesting to hypothesize why years of teaching experience negatively predict instruction. It could be related to a decrease in access to new research and related instructional strategies emerging in the field as educators are teaching longer. Indeed on average our participants, much like the general workforce, had already been teaching young children for over 11 years (Institute of Medicine and National Research Council, 2012) demonstrating a fair amount of time in the field. It may also be that, over time, educators use information gained from teaching experience to inform instruction (Buchmann, 1987; Elbaz, 1983) in ways that are not visible or aligned with our measure of instruction. Efforts to improve outcomes for children may need to consider and account for the negative association between educators' years of teaching experience and language and literacy instruction.

3.4. Limitations

Despite the introduction of a novel statistical method to examine associations of educators' knowledge and beliefs with instruction, some limitations of this study must be acknowledged. First, we only examined two types of knowledge; additional types of knowledge may also be important for instruction (Ben-Peretz, 2011; Shulman, 1987), especially given our minimal findings related to knowledge. Whereas this is one of the first studies to look at multiple types of knowledge simultaneously in relation to instruction, using other measures created by researchers to assess knowledge and its association with instruction would be beneficial for finding patterns across the literature. Another limitation of this study is that, for the purposes of our investigation, we have conceptualized language and literacy instruction in very specific ways. Although this allowed us to align our measures of beliefs with our measures of instruction, and other researchers have

operationalized instruction in this way (Fuligni et al., 2012; Sandvik et al., 2014), there are other ways of examining language and literacy instruction. More research examining the associations between educator characteristics and other operationalizations of instruction should be conducted using quantile regression. Relatedly, we were unable to find associations among our variables of interest and Reading. One hypothesis for this finding is that the increased focus on the importance of reading instruction over the past several decades through PD (Landry, Swank, Smith, Assel, & Gunnewig, 2006; Whitehurst et al., 1994) and other awareness activities (NAEYC, 2009) has alerted educators to the importance of engaging children in emergent reading activities. Those wishing to improve reading-related instruction to young children may need to determine if there are other educator characteristics that do predict amount of reading instruction. An additional limitation is that educators were allowed to select the instruction to be observed, which may have led to some selection bias regarding the aspects of instruction educators made available for viewing, although this was controlled for, in part, by including the length of observation in the analyses. It should also be noted that the reliability levels for our beliefs subscales were lower than traditionally acceptable levels; although this may be due to the nature of the Beliefs measure, findings nonetheless should be interpreted with caution and replicated in future work. Finally, although the distribution of participants' with an early childhood-related degree and the average number of years of teaching experience were similar to that of the early childhood workforce as a whole (Institute of Medicine and National Research Council, 2012), more research is necessary to understand the generalizability of these findings and extend this research to larger samples.

4. Conclusion

Overall, associations among educator characteristics appear to be more complex than they appear in previous work. The use of quantile regression allowed for insight into associations along a distribution of instruction, including strong floor effects for at least 50% of the participants. When there was instruction to predict, our analyses revealed differential associations of educators' knowledge, beliefs,

education, and teaching experience with language and literacy instruction, helping to clarify the findings in the extant literature. Our observed differential associations of educator characteristics with instruction indicate that both *what* we measure and *how* we measure these constructs matters, and has implications for efforts aimed at improving language and literacy instruction and supports the need for more nuanced research on educator instruction.

Acknowledgments — The research reported here was supported by the Institute of Education Science, U.S., Department of Education, through R305E100030 and Grant R305B12008 to The Ohio State University. This work would not have been possible without the contributions of other investigators and collaborators including: Ann O’Connell, individuals from the Early Childhood Quality Network such as Dennis Sykes, Sharon Sullivan, Kathryn Rider, and Melissa Ross, or the cooperation of the Ohio Department of Education’s Office of Early Learning and School Readiness. We also express deep appreciation for the early childhood agencies, administrators, educators, and PD facilitators involved, as well as the research staff members responsible for coordinating and executing data collection and other research activities. The opinions expressed are those of the authors and do not necessarily represent the views of the Institute of Education Sciences, U.S. Department of Education, Early Childhood Quality Network, or Ohio Department of Education.

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Appendix A. Adapted individual student instructional coding scheme

<i>Code</i>	<i>Definition</i>	<i>Examples</i>
Code instruction	Instruction explicitly focused on fostering children's later decoding skills	
Phonological awareness	Instruction aimed at increasing children's understanding and awareness of, and ability to manipulate individual speech sounds	An educator asks children to produce rhymes (e.g., what rhymes with/hop/?), or determine the number of syllables in a given word
Morpheme awareness	Instruction aimed at increasing children's familiarity with the meanings of word parts in relation to larger words	Children are breaking apart compound words into separate meaning-based components, or turning singular words into plural versions
Word identification/decoding	Instruction that provides children practice with identifying single, printed words	An educator holds up name cards and asks children to stand when they see their name, or to recite the days of the week while tracking the days on a calendar
Word identification/encoding	Instruction that provides children with practice spelling single, printed words	Children are copying their names or sounding out and using invented spelling to write singular words
Alphabet knowledge	Instruction that explicitly focuses on a specific letter-sound correspondence and letter names	Educators name a letter and ask children to state its sound (e.g., what sounds does B say?), or children generate a list of words that start with a specified letter
Oral language and vocabulary	Instruction explicitly focused on teaching children to extract and construct meaning from text or language	
Oral language	Instruction that aims to increase children's oral vocabulary, listening, and speaking abilities	Children and/or educators engage in a back and forth exchange, sharing personal information, or in a class discussion about vocabulary meaning or use
Print vocabulary	Instruction that aims to increase children's print vocabulary (e.g., ability to access a word's meaning in its written form)	An educator writes a word on the whiteboard and the class discusses its meaning, or the educator draws attention to a word during a shared writing or reading activities
Reading	Instruction explicitly focused on providing exposure to reading activities or teaching children comprehension or text orientation strategies	
Print and text concepts	Instruction that familiarizes children with the general forms, purposes, and structures of print	An educator highlights the author, illustrator, title, or Table of contents before reading a book aloud, or explicitly provides instruction about text orientation or letter concepts
Listening and reading comprehension	Instruction that aims to increase children's comprehension of written or orally read text	An educator asks children to predict what will occur in a book based on their own knowledge or experiences, or the class acts out a book they have read to retell the story
Text reading	Instruction that involves children and/or educators reading connected text	An educator is reading a story aloud to a class, or individual children are reading books to themselves during choice time
Writing	Instruction that involves the production of written connected text, or explicit instruction about the process of producing that written connected text	A group of children generate ideas for a story, and an educator writes those ideas down on the board, or children write about the things they did on a field trip, or receive handwriting instruction