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# The nature and extent of change in early childhood educators' language and literacy knowledge and beliefs

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## HIGHLIGHTS

- We examine early childhood educators' change in literacy knowledge and beliefs.
- Educators made small growth the year that professional development was provided.
- Educators' growth plateaued into the subsequent school year.
- Educators' openness to change predicted their outcomes in literacy knowledge.
- Educators' level of self-efficacy predicted their outcomes in literacy beliefs.

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## ABSTRACT

Professional development (PD) can enhance educators' knowledge and beliefs, but research has yet to determine the nature and extent of such change. This study examined the patterns and predictors of change in knowledge and beliefs for early childhood educators participating in state-implemented PD. Results from a longitudinal piecewise growth model indicated that educators improved their knowledge and beliefs to varying extents during the school year when PD was provided. Change then plateaued with educators neither improving nor regressing during the subsequent school year. Openness to change and self-efficacy significantly predicted knowledge and beliefs, respectively. Research and practice implications are provided.



The delivery of effective language and literacy instruction is associated with the language and literacy knowledge and beliefs possessed by educators (Dickinson & Brady, 2006; Piasta, Connor, Fishman, & Morrison, 2009). Professional development (PD) projects in the United States and other countries have demonstrated that early childhood (EC) educators have the potential to develop their language and literacy knowledge and beliefs (Cunningham, Zibulsky, & Callahan, 2009; Hamre et al., 2012; Wood & Bennett, 2000). Yet, we have much to learn about educator change as a result of large-scale PD efforts, such as those offered by states or required by recent initiatives (e.g., federal Early Learning Challenge grants in the U.S.). Although many large-scale efforts to date have demonstrated positive impacts on EC educators' knowledge and beliefs, others have not been entirely successful (LeMoine, 2008; Neuman & Cunningham, 2009; Whitebook & Ryan, 2011) . Moreover, extant evidence (Ciyer, Nagasawa, Swadener, & Patet, 2010; Goldschmidt & Phelps, 2010) and adult learning theory (Clarke & Hollingsworth, 2002) lead to hypotheses suggesting that change may be differential among educators and that such change may be related to measurable factors such as educators' initial knowledge and beliefs, self-efficacy, and openness to change. For these reasons, we were interested in examining growth in the knowledge and beliefs of EC educators participating in a large state-funded PD

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program and determining factors associated with such change over time. Specifically, we examined the nature and extent of growth in language and literacy knowledge and beliefs over an 18-month period and whether such growth was predicted by educators' initial knowledge and beliefs, self-efficacy, and openness to change.

## 1. EC educators' language and literacy knowledge and beliefs

Language and literacy knowledge refers to educators' understanding of the core early literacy components (e.g., oral language, phonemic awareness). Some research indicates that EC educators' levels of language and literacy knowledge are lower than anticipated (Cunningham et al., 2009) and that variation exists among educators in their knowledge (Crim et al., 2008; Hindman & Wasik, 2011). For example, when the literacy-related knowledge of a heterogeneous group of EC educators was assessed using the *Informal Survey of Linguistic Knowledge* (Moats, 1994), between 40% and 85% of educators provided incorrect responses for items assessing phonemic awareness (Crim et al., 2008). Such knowledge is crucial for educators because research suggests that it may influence children's emergent literacy growth (e.g., Poshajski, Mather, Nathan, & Sammons, 2009). Further, EC educators providing instruction in Head Start centers have demonstrated more knowledge about some components of language and literacy (e.g., oral language; Hindman & Wasik, 2011) compared with others (e.g., phonemic awareness; Hindman & Wasik, 2011). Collectively, these results indicate that great variability exists among EC educators with respect to their language and literacy knowledge and that some EC educators are lacking basic knowledge relevant for providing meaningful literacy learning opportunities to young children.

Language and literacy beliefs refers to what educators "assume, think, and know about how young children develop literacy skills; what they perceive a teacher's role in the process to be; and how they feel they should implement these practices in a classroom" (Hindman & Wasik, 2011, p. 480). Similar to the literature on educators' literacy-related knowledge, EC educators in the United States and abroad have varying beliefs about language and literacy instruction and how children's emergent literacy develops (e.g., Lynch, 2009; O'Leary, Cockburn, Powell, & Diamond, 2010). Additionally, many Head Start educators have been found to hold similar language and literacy beliefs with regard to certain literacy practices (e.g., book reading; Hindman & Wasik, 2011), but they maintain dissimilar beliefs about other literacy-related practices (e.g., writing; Hindman & Wasik, 2011). Unfortunately, some beliefs held by EC educators are misaligned with research and theory in emergent literacy development (Hindman & Wasik, 2011; Powell, Diamond, Bojczyk, & Gerde, 2008). For example, in Powell and colleagues' (2008) study, many of the participating Head Start educators indicated that children needed to be "ready" to engage with literacy materials before literacy development could occur – a belief contrary to the tenets of emergent literacy theory (Whitehurst & Lonigan, 1998). It is critical that EC educators possess literacy-related beliefs that are aligned with research and theory, because these beliefs are positively related to the learning opportunities provided to children (e.g., Meehan, 2007; Ure & Raban, 2001). Therefore, to enhance the literacy-related learning opportunities experienced by children, EC educators may need support to more closely align their language and literacy beliefs with that of current research and theory.

Many researchers have argued that language and literacy PD is necessary to enhance educators' literacy-related knowledge and beliefs, thereby better supporting the use of research-aligned practices and, ultimately, children's emergent literacy development (Crim et al., 2008; Lee & Ginsburg, 2007; Neuman & Wright, 2010; Phillips & Morse, 2011; Piasta, Justice, McGinty, & Kaderavek, 2012). Whereas some research has demonstrated that language and literacy PD can have positive impacts on EC educators' knowledge and beliefs (Hamre et al., 2012; Hindman & Wasik, 2011; Scott-Little et al., 2011), other research studies have shown limited improvement on such outcomes (Breffni, 2011; Neuman & Cunningham, 2009). Moreover, even within studies showing positive impacts of PD, change does not occur on a consistent basis for all educators (Neuman & Cunningham, 2009; Pianta, Mashburn, Downer Hamre, & Justice, 2008). For example, Neuman and Cunningham (2009) found that EC educators varied in their knowledge and practices, with educators in center-based settings having greater literacy-related knowledge and practices than educators in home-based settings at pre-test. Further, when assessing change over time, home-based educators demonstrated significantly greater change in their practices than center-based educators. Subsequently, many scholars (e.g., Justice, Mashburn, Hamre, & Pianta, 2008; Piasta et al., 2010; Sheridan, Edwards, Marvin, & Knoche, 2009; Snyder, Hemmeter, & McLaughlin, 2011) have argued that additional research is warranted to identify under what conditions, and for whom, PD opportunities are associated with change.

### 1.1. Factors contributing to educator change

In the current study, we focused not only on the extent to which EC educators participating in a large, state-funded PD changed their language and literacy knowledge and beliefs, but also for whom and under what conditions such changes occurred. We examined three factors hypothesized to relate to educators' change in knowledge and beliefs: self-efficacy, openness to change, and initial knowledge/beliefs. These three factors were selected not only based on research and theory, as described below, but because each represents a potentially malleable factor or additional target of PD that could result in more positive PD outcomes. Although the research described below does not provide a comprehensive summary of the predictors selected, it offers a focused selection of research that have direct application to the content of this paper. For more thorough summaries of the research on these topics, see Tschannen-Moran and Hoy (2001) or Usher and Pajares (2008) for self-efficacy, Meyer (2013) for openness to change, and Clarke and Hollingsworth (2002) for relations between initial status and growth. Notably, researchers have yet to directly examine how these factors are associated with educator change in language and literacy knowledge and beliefs.

#### 1.1.1. Self-efficacy

Self-efficacy refers to individuals' perceived confidence in their own abilities to produce specific outcomes (Bandura, 1997) and is an important belief related to educators' effectiveness in acquiring new instructional skills, using instructional practices in the classroom, and achieving positive child outcomes (Goddard, Hoy, & Hoy, 2000; Guskey, 1988; Holzberger, Philipp, & Kunter, 2013; Overbaugh & Lu, 2008; Pajares, 1992; Stein & Wang, 1988). Educators' levels of self-efficacy can vary based on the content they are teaching (Ross, Cousins, & Gadalla, 1996) and may change after applying knowledge gained through PD opportunities (Ross, 1994). Educators who feel more efficacious tend to have higher levels of participation in PD (Geijsel, Sleegers, Stoel, & Krüger, 2009), which in turn, may predict their outcomes (Berkel, Mauricio, Schoenfelder, & Sandler, 2011; Domitrovich, Gest, Gill, Jones, & DeRousie, 2009). Notably, educators' level of self-efficacy is also related to their openness to change and use of new practices (Guskey, 1988; Smylie, 1988); yet, research is warranted to determine whether self-efficacy specifically predicts educators' change

in language and literacy knowledge and beliefs.

#### 1.1.2. Openness to change

Educators' openness to change refers to the degree to which they are willing to entertain new information, try new instructional methods, and risk making mistakes (Vannatta & Fordham, 2004). Educators' openness to change has predicted their competence, use of new practices, and implementation fidelity (Baylor & Ritchie, 2002; Blau & Peled, 2012; Domitrovich et al., 2009; Jones, Jimmieson, & Griffiths, 2005). Additionally, research with health care professionals has found openness to change to be an important predictor of participation in PD activities, as well as satisfaction with and use of new practices (Cunningham et al., 2009). Collectively, these studies suggest the importance of openness to change in the uptake of PD content and showcase the potential of this factor to predict change in educators' knowledge and beliefs.

#### 1.1.3. Initial level of knowledge and beliefs

According to the constructivist orientation of adult learning theory, learning is a process that incorporates an individual's prior knowledge and experiences to make meaning of new information and construct knowledge (Prawat, 1992). Given this framework, it is essential to consider educators' initial knowledge and beliefs when evaluating their growth. Some researchers (e.g., Wilkins, 2008) have found that educators' use of effective practices and their growth in knowledge and beliefs is related to their prior knowledge and beliefs. To illustrate, educators with higher knowledge at the beginning of PD may have less – or more challenging – growth to make and therefore may demonstrate slower growth rates than educators with initially lower knowledge. Moreover, research and theory also indicate that educators' knowledge and beliefs are interrelated (Pajares, 1992; Prawat, 1992). For example, educators may choose not to further develop or apply their knowledge if it misaligns with their beliefs (Lin, 2013). Similarly, educators may be more receptive to PD opportunities if they believe the content is important (Goldschmidt & Phelps, 2010; Lin, 2013). Consequently, educators with stronger beliefs may be more receptive to PD and have greater knowledge gains as a result. Conversely, educators who have higher initial levels of knowledge may not be as invested in PD, because they may not believe that they need to change (Cunningham et al., 2009). Together, these findings suggest that educators' outcomes and rate of growth may vary based upon their initial levels of knowledge and beliefs.

### 1.2. The current study

In the current study, we addressed two specific research questions informed by the extant literature. First, we asked: What is the nature and extent of change over time in the language and literacy knowledge and beliefs of EC educators participating in PD? In addressing this question, we applied growth curve modeling techniques to add to the current literature, which has most often examined change in educator knowledge and beliefs between only two time points (Hamre et al., 2012; Neuman & Cunningham, 2009) and without attention to the extent to which change is sustained long-term (cf. Antoniou & Kyriakides, 2013; Goldschmidt & Phelps, 2010). Growth curve modeling was particularly appropriate given our interest in measuring both extent and rate of change, as well as antecedents of that change within and between educators (Preacher, Wichman, MacCallum, & Briggs, 2008). Moreover, our application of piecewise growth curve modeling afforded the opportunity to test specific hypotheses regarding the short- and long-term growth in EC educators' knowledge and beliefs: We hypothesized that there would be immediate growth after receiving PD, that the growth would be variable, and that it would slow when outcomes were assessed the following school year (Goldschmidt & Phelps, 2010; Pianta et al., 2008; Scott-Little et al., 2011). As a second research question, we asked: To what extent do EC educators' self-efficacy, openness to change, and initial levels of knowledge and beliefs predict their growth in language and literacy knowledge and beliefs? We hypothesized that each of these factors would predict the rate of growth, as well as final levels in EC educators' language and literacy knowledge and beliefs.

## 2. Methods

### 2.1. Participants

Participants in this study represent EC educators from the first two cohorts of a four-cohort longitudinal study conducted in a large Midwestern state. All participants were part of a state-wide evaluation of PD and were recruited during registration for the state's PD program. Participation in the PD was open to all EC educators working with preschool children and counted toward the 10 h of PD required every other year for EC program licensing. Communication with potential research participants was arranged through contact with the state PD provider. EC educators who provided informed consent to voluntarily participate in the research study were randomly assigned to one of three instantiations of a state-sponsored PD program; in this paper we focus only on those participants who received PD specific to early literacy, which aimed to support their implementation of the state's early language and literacy learning standards.

Our sample included 87 EC educators who were roughly equally dispersed across rural ($n$ = 27), suburban ($n$ = 29), and urban ($n$ = 22) settings, with 32 working in public school settings, 41 in center-based settings, and two in home-based settings. Thirty-seven worked in Head Start programs. The average age of the educators was 46.19 years ($SD$ = *11.77*), and they had an average of 11.10 years ($SD$ = *7.71*) of experience in EC settings. There was a range in the highest level of education achieved, including at least a Master's degree ($n$ = 37), Bachelor's degree ($n$ = 14), Associate's degree ($n$ = 20), and less than a two-year degree ($n$ = 13). Educators were mostly female ($n$ = 84) and Caucasian ($n$ = 68), but our sample also included three male participants, as well as 16 educators of African American descent and one educator of Asian descent. Forty-nine participants were lead educators, 12 were co-educators, and 16 were assistant educators.

### 2.2. Professional development

The language and literacy PD was funded by the state's Department of Education and provided at no cost to participating educators. The PD focused on enhancing EC educators' provision of high-quality language and literacy experiences. It consisted of a 30-hr face-to-face module spanning five months in which EC educators engaged in ten 3-hr sessions to build knowledge and practice pertaining to five early literacy learning domains: environment, play, oral language, early reading, and early writing. Each of the five literacy domains included two 3-hr sessions delivered in either one full-day or two half-day formats. The PD was developed and implemented via contract with the Early Childhood Quality Network (ecQ-net). EcQ-net collaborated with early literacy experts from institutions of higher education to develop the modules, which included research-based language and literacy content, pedagogy, in-classroom practice, and individual reflection. Early language and literacy specialists funded through the state Department of Education were trained by ecQ-net staff and delivered the PD modules, providing multiple offerings of the language and literacy PD at various locations across the state.

PD sessions emphasized intentional teaching strategies geared to promote children's language and literacy development, following a consistent format that included (a) explorations (45–50 min), (b) implications and demonstrations (55–60 min), and (c) connections to teaching and learning (40–45 min). Explorations provided an introduction of the content, goals for the session, and activities to engage educators in discussion specific to current knowledge, beliefs, and practices relevant to the session's respective content domain (e.g., early writing). Implications and demonstrations offered specific content knowledge (e.g., principles of print-rich environments, functions of language, planning for phonological awareness) to enhance knowledge, provided information concerning educators' roles in supporting children's literacy learning (e.g., early language and literacy standards, evidence-based classroom practices, continua of reading and writing development) to develop both knowledge and beliefs, provided examples and demonstrations from model EC educators (e.g., case studies, family literacy examples, child work samples) to enhance knowledge, beliefs, and practices, and offered a *time to try* (e.g., opportunities during the PD for educators to try activities related to content presented) to facilitate use of new practices. Finally, connections to teaching and learning summarized the session's content and goals (e.g., review of key terms and reflection on knowledge, beliefs, and practices), as well as reviewed educators' *into practice* activities (e.g., a choice of two take-home options for educators to implement in their setting and document for discussion).

### 2.3. Dependent measures

The dependent measures related to educators' knowledge and beliefs were selected because they were targeted constructs of the language and literacy PD. These measures were included in a series of questionnaires completed by educators at multiple times during the school year in which they participated in PD (fall prior to or in conjunction with the start of PD [baseline fall], winter at the conclusion of PD, and spring) as well as in the fall of the following school year to assess any long-term, sustained change (distal fall).

#### 2.3.1. Teacher knowledge assessment of early language and literacy development

In order to measure educators' knowledge of language and literacy instructional practices, the present study used the Teacher Knowledge Assessment of Early Language and Literacy Development (TKA; Neuman & Cunningham, 2009). The measure consists of 50 multiple-choice and 20 true-false items (e.g., Children's early vocabulary development is a strong predictor of later reading achievement.). Forty-eight of these items addressed the following eight core competencies: letter knowledge, literacy assessments, literacy curriculum, oral language comprehension, parental role in language and literacy development, phonological awareness, print conventions, and strategies for working with second language learners. The remaining 22 items addressed the fundamentals of child development as indicated in the National Association for the Education of Young Children (2005) standards. Responses were scored as correct or incorrect, with the total score representing the sum of all correct responses (range 0–70). Overall internal consistency was reported by the measure creators as Cronbach's alpha = 0.96 (Neuman & Cunningham, 2009), with Cronbach's alpha equal to 0.78 in this study.

#### 2.3.2. Preschool teacher literacy beliefs questionnaire

The Preschool Teacher Literacy Beliefs questionnaire (TBQ) measures educator beliefs regarding literacy development and instruction (Hindman & Wasik, 2011). The TBQ consists of 30 statements concerning educators' beliefs about the development of language and literacy skills and specific early language and literacy instructional practices; content draws upon research and best practice concerning language and literacy and covers four domains: code-based skills ($n = 9$), oral language and vocabulary ($n = 9$), book reading ($n = 5$), and writing ($n = 6$). Educators indicate their agreement with each statement using a five-point Likert scale. For example, educators reported the extent to which they agreed with the belief that scribbling and drawing was a waste of time. Educators' responses to each item were averaged to create a total TBQ score (range 0–4) in which higher scores indicate beliefs more aligned with current research-based developmentally-appropriate literacy practices. To increase interpretability across the two outcome measures used in this study, we used a linear transformation of scores (multiplied the total TBQ score by 20) to make the scale (new range 0–80) more similar to the scale of TKA (range 0–70). TBQ's creators reported the reliability of the measure to be $\alpha = .87$ (Hindman & Wasik, 2011); $\alpha = .68$ in the current study.

### 2.4. Independent measures

Independent measures assessed the three factors hypothesized to predict change in educators' knowledge and beliefs. Measures of educators' self-efficacy, openness to change, and initial knowledge/beliefs were also included in the series of questionnaires completed by educators at multiple times during the school year in which they participated in PD (i.e., baseline fall, winter, spring) and the following school year (distal fall). However, given the goals of the present study, only data from baseline fall questionnaires were used as predictors in the current analyses.

#### 2.4.1. Self-efficacy scale

The Efficacy to Promote Language and Literacy Learning scale was created as a result of earlier work by Author and colleagues (2008) and Arthur, McCormick, and Bovaird (2012) which adapted the Bandura Teacher Self-Efficacy Scale (1997), used in the National Institute of Child Health and Human Development's Study of Early Child Care and Youth Development, to pertain specifically to feelings of efficacy concerning building early language and literacy skills. This measure was selected given its previous use in other large-scale studies (e.g., Justice et al., 2008; Language and Reading Research Consortium, 2015), strong psychometric properties (Arthur et al., 2012), and direct alignment with the content focus (i.e., language and literacy) of the PD. The final version of this scale includes five items ($\alpha = .92$; Arthur et al., 2012) for which educators indicate their feelings of efficacy regarding their perceived abilities to impact children's language and literacy learning. Educators responded to each statement using a five-point Likert scale. Item-level responses were averaged to create a composite score (range 0–4) in which higher scores represented greater feelings of efficacy. Cronbach's alpha for this study was 0.94.

#### 2.4.2. Openness to change scale

The openness to change scale was created by combining four items from Vannatta and Fordham (2004) measure of openness to change regarding new instructional practices (e.g., I am comfortable trying new things even when I will probably make mistakes) and three items from Neuman and Cunningham (2009) measure of openness to change specific to language and literacy instruction (e.g., I am interested in learning more about how to support children's language development). Educators indicated the extent of agreement to each statement using a 5-point Likert scale with higher scores indicating a greater openness to change. Previous psychometric studies of this scale indicated unidimensionality (Arthur et al., 2012); thus, responses were averaged to create a

single composite score. Cronbach's alpha for this measure for the present study was 0.70.

## 3. Results

### 3.1. Preliminary analyses

Variables were examined using IBM SPSS Version 22.0 for fit between their distributions and the assumptions of multivariate analysis. The distributions of the variables were approximately normal. Analysis of the patterns of missing data for the 87 educators indicated that 24 educators had values only at three of the four time points: baseline fall, winter, and spring; 5 had values at baseline fall and winter; and 4 had values at baseline only. Little's MCAR test was not significant ($\chi^2 = 159.63$, $df = 146$, $p = .208$); consequently, the 33 educators with waves of missing data were included in the HLM analyses with full maximum likelihood and no additional missing data adjustments. For the remaining 54 educators, wave-specific missing data were addressed by multiple imputation (Little's MCAR for these teachers was nonsignificant, $\chi^2 = 43.55$, $df = 51$, $p = .761$) using the EM algorithm through NORM 2.03 (Schafer, 1999). Thus, 10 imputed data sets were used in the analyses to produce pooled results.

Across the four waves of data collection, educators' minimum knowledge scores ranged from 21 to 25 questions answered correctly and maximum scores ranged from 57 to 60 questions. Mean knowledge scores were 44.56 ($SD = 7.10$), 45.58 ($SD = 6.96$), 47.07 ($SD = 6.51$), and 45.36 ($SD = 7.68$) for baseline fall, winter, spring, and distal fall, respectively. Educators' minimum belief scores ranged from 35 to 39 questions and maximum scores ranged from 57 to 59 questions across the four waves of data collection. Mean belief scores were 48.59 ($SD = 4.85$), 49.66 ($SD = 4.82$), 49.99 ($SD = 4.66$), and 49.86 ($SD = 5.27$) for baseline fall, winter, spring, and distal fall, respectively.

### 3.2. Nature and extent of change over time

We used HLM 7.01 (Raudenbush, Bryk, & Congdon, 2010) to examine educators' growth on TKA and TBQ across four time points: baseline fall, winter, spring, and distal fall (fall of the school year following the PD). Time was coded as the number of months since baseline fall because measurement occasions varied by educator. Visual inspection of the raw data indicated that rates of growth tended to be steeper during the school year when PD was provided and flattened out when educators were assessed in the fall of the following school year. Therefore, we fit piecewise models to the data with time coded in two phases: number of months between baseline fall and spring (Phase 1) and number of months from spring to distal fall (Phase 2). Since we were interested in predicting final knowledge and belief status, time was centered at distal fall.

First, unconditional growth models were fit for each outcome. In the model for TKA with random intercepts and random slopes, variance in the TKA intercepts was statistically significant ($\tau_{00} = 71.44$, $p < .001$) indicating significant heterogeneity in educators' initial scores on TKA. The Phase 1 slope was positive and significant ($\gamma_{10} = 0.27$, $p = .004$) and the Phase 2 slope was slightly negative, but not significant ($\gamma_{20} = -0.06$, $p = .086$). Variance in the TKA Phase 1 slopes was significant ($\tau_{11} = 0.29$, $p < .001$), but not for the Phase 2 slopes ($\tau_{22} = 0.01$, $p = .068$). Educators' literacy knowledge improved, on average, only during the school year of PD although there was significant variability in the degree of linear change in the slopes during Phase 1. After Phase 1, TKA tended to remain stable with no additional change between spring and fall of the next school year. Thus, the best fitting unconditional growth model for TKA had random intercepts, random slopes at Phase 1, and a fixed slope at Phase 2. Results are presented in Table 1 and Fig. 1.

In the unconditional growth model for TBQ with random intercepts and random slopes, variance in the intercepts was significant ($\tau_{00} = 36.19$, $p < .001$) indicating significant differences in educators' initial scores on TBQ. The Phase 1 slope was positive and significant ($\gamma_{10} = 0.24$, $p = .008$) but not significant for the Phase 2 slope ($\tau_{22} = 0.001$, $p = .988$). Variances in the Phase 1 and Phase 2 slopes were both significant ($\tau_{11} = 0.31$, $p < .001$ and $\tau_{22} = 0.03$, $p = .002$). Educators' literacy beliefs improved only during the school year of PD and there was significant variability in the slopes during both phases. Although growth was significant only during Phase 1 and because variation was significant during both phases, the best fitting unconditional growth model for TBQ had random intercepts and random slopes at Phase 1 and Phase 2 (Table 1; Fig. 2).

### 3.3. Prediction of outcome and growth

To estimate the extent to which EC educators' self-efficacy, openness to change, and initial levels of literacy knowledge and beliefs predicted their language and literacy knowledge and belief outcomes and growth, we added all three predictors to the best fitting unconditional growth models (Table 2). We used backward elimination dropping variables with the largest $p$-values to select the final predictors in each model (West, 2015). As seen in Table 2, in the final model, only openness to change (Openness) met our criterion of $p < .05$ as a predictor of the intercept for TKA ($\gamma_{01} = 4.48$, $p = .002$), indicating that for each one point increase on the openness to change scale, there was a 4.48 point increase on TKA at distal fall. Only self-efficacy (Self-efficacy) was a significant predictor of the TBQ intercept ($\gamma_{01} = 2.64$, $p < .001$), indicating that for every one point increase on the self-efficacy scale, there was a 2.64 increase on TBQ at distal fall.

We were also interested in examining the extent to which initial TKA scores predicted growth in TKA and initial TBQ scores predicted growth in TBQ. Thus, we used latent growth curve modeling to investigate the effect that educators' latent initial TKA score had on their rate of growth in literacy knowledge and the effect that their latent initial TBQ score had on their rate of growth in literacy beliefs (Preacher et al., 2008). Time was coded as number of months since baseline and centered at baseline fall to assess growth rate from initial status. Since results of the initial analyses indicated that growth only occurred during Phase 1, we used the first three waves of data (baseline fall, winter, and spring) in the latent variable analyses.

Results indicated that initial TKA was not a significant predictor of educators' rate of growth on TKA ($\gamma_{11} = -1.17$, $p = .526$). Results for TBQ, however, indicated that, on average, educators with higher initial scores on TBQ grew at a significantly slower rate than their peers ($\gamma_{11} = -3.13$, $p = .035$). Results are presented in Table 3.

## 4. Discussion

EC educators' knowledge and beliefs are important constructs related to their practices and children's development. This study had two research questions that sought to explain how EC educators change in their language and literacy knowledge and beliefs after attending a large-scale PD. Below, we discuss important findings regarding the patterns in which educators change in their knowledge and beliefs and the relation of these patterns to factors such as self-efficacy and openness to change.

**Table 1**
Best fitting unconditional growth models with TKA and TBQ as outcomes (n = 87).

| Parameters & predictors | TKA random intercepts, random slope at Phase 1 only | TBQ random intercepts, random slopes |
|---|---|---|
| Intercept | | |
| $\gamma_{00}$ | 47.17** | 51.73** |
| $\tau_{00}$ (variance) | 71.44** | 36.19** |
| Slope | | |
| Phase 1 ($\gamma_{10}$) | 0.27* | 0.24* |
| $\tau_{11}$ (variance) | 0.29** | 0.31** |
| Phase 2 ($\gamma_{20}$) | −0.06 | 0.001 |
| $\tau_{22}$ (variance) | – | 0.03* |
| $\sigma^2$ (resid. variance) | 8.00 | 5.12 |

Note. TKA = Teacher Knowledge Assessment of Early Language and Literacy Development; TBQ = Preschool Teacher Literacy Beliefs questionnaire; Phase 1 = Number of months from baseline to spring; Phase 2 = Number of months from spring to distal fall. Centered at final time point. Method of estimation = full maximum likelihood.
** = significant at p < .001, * = significant at p < .05.

### 4.1. Research question 1: patterns of educators' growth in knowledge and beliefs

The first aim of this study was to determine the extent and patterns of growth in EC educators' language and literacy knowledge and beliefs over time. Educators made small, linear growth for both knowledge and beliefs throughout the school year that PD was provided. Further, we found that educators' outcomes plateaued when assessed the school year following PD. Results from previous literature on educators' long-term outcomes have varied with some findings indicating that educators declined in their knowledge from post-test to long-term follow-up (Goldschmidt & Phelps, 2010) and other findings demonstrating that educators sustained their outcomes (Antoniou & Kyriakides, 2013). Our results extend previous research by providing evidence that EC educators can make small sustainable gains in their knowledge and beliefs during PD provided on a large-scale by state Departments of Education. Although these results should not be over-generalized, they provide evidence that changes in knowledge and beliefs occurring during PD can be maintained by EC educators into the subsequent school year.

We found meaningful variation in EC educators' growth rates at Phase 1 (pre-test to post-test) but not Phase 2 (post-test to follow-up). With respect to Phase 1, we found that educators' growth rates in both knowledge and beliefs varied by individual educators over time. For Phase 2 educators did not vary significantly in their growth rates for knowledge, but they did for beliefs. Although the variation in language and literacy belief growth rates was significant, it was marginal ($\tau_{22}$ = 0.00008), and in our opinion, lacking practical importance. Our findings from Phase 1 converge with the research literature, which indicate that educators vary in their rate of change on targeted outcomes when completing PD (Desimone, Smith, & Phillips, 2013). Our findings from Phase 2 differ from the results of other researchers. Although there is less research on growth rates from post-test to long-term follow-up, the literature suggests that educators continue to vary in their rates of growth into follow-up (Goldschmidt & Phelps, 2010). Our results support previous research indicating that short-term outcomes in knowledge and beliefs are obtained at varying rates, but contrary to the literature, our results indicate that outcomes may be sustained from post-test to follow-up at fixed rates. These results suggest that EC educators' knowledge and belief growth will vary, but that once growth occurs, educators are likely to maintain their outcomes. Given that EC educators participate in PD opportunities intermittently and that they infrequently receive follow-up support for the PD content (Penuel, Fishman, Yamaguchi, & Gallagher, 2007), sustainable outcomes are critical for the continued development of educators in the field and the children in their classrooms. Consequently, future research should investigate which aspects of PD are likely to result in growth in EC educators' knowledge and beliefs as well as PD-related factors that influence the sustainability of educators' outcomes.

### 4.2. Research question 2: predictors of educators' knowledge and beliefs

There were three key findings related to our second research question identifying predictors of growth and outcomes in EC educators' knowledge and beliefs. Our hypotheses were partially supported and these, along with their implications, are discussed.

#### 4.2.1. Predictors of EC educators' growth

Our first finding, that none of the independent variables predicted EC educators' rates of growth in language and literacy knowledge, was surprising given the extant research. Unlike knowledge, there was one predictor of growth rates in language and literacy beliefs: educators' initial beliefs. We found it interesting that initial beliefs predicted educators' rate of growth in beliefs, but initial knowledge did not predict knowledge growth. For educators' knowledge, these outcomes imply that in general, educators with higher and lower knowledge experience growth at the same rate. Conversely, for educators' beliefs, those with lower initial levels grew at faster rates. Thus, state-implemented PD may

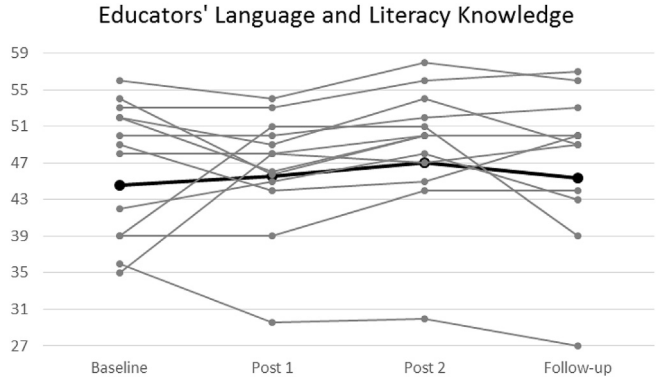


**Fig. 1.** Patterns of growth for early childhood educators' language and literacy knowledge. The mean growth curve line is presented in the bold black line with a random 20% of the data presented in thin gray lines.

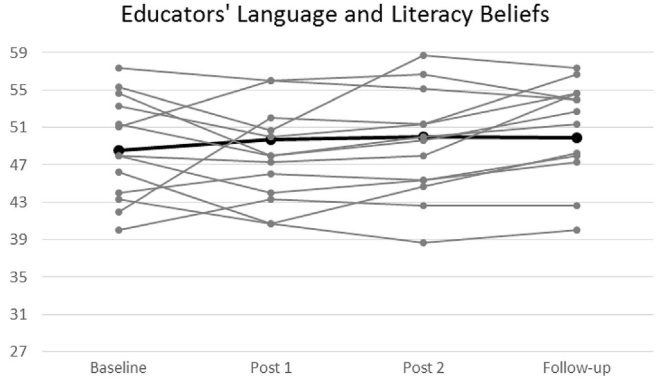


**Fig. 2.** Patterns of growth for early childhood educators' language and literacy beliefs. The mean growth curve line is presented in the bold black line with a random 20% of the data presented in thin gray lines.

**Table 2**
Conditional growth models with TKA and TBQ as outcomes (n = 87).

| Parameters & predictors | TKA all predictors | TKA Final Model | TBQ all predictors | TBQ Final Model |
|---|---|---|---|---|
| Intercept | | | | |
| $\gamma_{00}$ | 48.30** | 47.27** | 50.49** | 51.81** |
| $\tau_{00}$ (variance) | 57.43** | 64.57** | 33.04** | 34.24** |
| Slope | | | | |
| Phase 1 ($\gamma_{10}$) | 0.77* | 0.28* | 0.12* | 0.25* |
| $\tau_{11}$ (variance) | 0.27** | 0.30** | 0.31** | 0.32** |
| Phase 2 ($\gamma_{20}$) | −0.06 | −0.06 | −0.003 | −0.001 |
| $\tau_{22}$ (variance) | – | – | 0.03* | 0.03* |
| $\sigma^2$ (resid. variance) | 8.05 | 7.99 | 5.13 | 5.11 |
| Predictors of the intercept | | | | |
| Openness ($\gamma_{01}$) | 3.87 | 4.48* | −0.17 | – |
| Self-efficacy ($\gamma_{02}$) | 1.81 | – | 2.58* | 2.64** |
| Attendance ($\gamma_{03}$) | −0.44 | – | 0.65 | – |
| InitK/InitB ($\gamma_{04}$) | 0.34 | – | 0.17 | – |
| Predictors of Phase 1 slope | | | | |
| Openness ($\gamma_{11}$) | −0.01 | – | −0.17 | – |
| Self-efficacy ($\gamma_{12}$) | 0.19 | – | 0.02 | – |
| InitK/InitB ($\gamma_{14}$) | 0.01 | – | 0.01 | – |
| Predictors of Phase 2 slope | | | | |
| Openness ($\gamma_{11}$) | – | – | 0.16 | – |
| Self-efficacy ($\gamma_{12}$) | – | – | 0.12 | – |
| InitK/InitB ($\gamma_{14}$) | – | – | 0.54 | – |

Note. TKA = Teacher Knowledge Assessment of Early Language and Literacy Development; TBQ = Preschool Teacher Literacy Beliefs questionnaire; Openness = Openness to Change scale; Self-efficacy = The Efficacy to Promote Language and Literacy Learning scale; InitB = Initial score on TBQ (used a predictor of TKA), InitK = Initial score on TKA (used as a predictor of TBQ). All predictors were centered at the grand mean. Phase 1 = Number of months from baseline to spring; Phase 2 = Number of months from spring to distal fall. Centered at final time point. Method of estimation = full maximum likelihood. ** = significant at $p < .001$, * = significant at $p < .05$.

be equally beneficial for EC educators, regardless of the amount of knowledge possessed by educators at the start of the PD, but PD may be especially beneficial in enhancing the beliefs of educators in the most need of improvement – those with beliefs less aligned with research and theory. This finding implies that the gap between educators with higher and lower beliefs was narrower after PD than before, thereby promoting more equity for children with respect to their EC educators' language and literacy beliefs. For administrators and providers of PD, this finding holds practical importance as EC educators who possess beliefs in need of modification could be targeted as participants of the PD opportunities provided.

#### 4.2.2. Predictors of EC educators' outcomes

Our second finding was the positive, significant associations between EC educators' openness to change and their reported self-efficacy with their levels of knowledge and beliefs at distal fall, respectively. We note that these results should not be misattributed to the effects of PD. However, these results extend the research literature and provide important information about EC educator predispositions that may aid in answering the question posed by previous researchers, "for whom is PD associated with change?" (e.g., Piasta et al., 2010; Snyder et al., 2011).

Our results suggest that EC educators who are more open to change are likely to have greater language and literacy knowledge than educators who are less open to change. This finding extends the previous literature, which has found openness to change to be a significant predictor of educators' technology competence (Baylor & Ritchie, 2002) and use of technology practices (Blau & Peled, 2012). Nonetheless, this positive association should be explored further to better understand the relationship between educators' openness to change and their acquisition of content knowledge. Future research should also examine under what conditions educators change in their willingness to learn new content and try new practices, so the field can provide more support to educators who are less open to change.

Additionally, our results suggest that EC educators with higher levels of self-efficacy were likely to have literacy-related beliefs that more closely aligned with emergent literacy theory. Previous researchers have found associations between educators' self-efficacy and their instructional quality (Holzberger et al., 2013) and use of new practices (Stein & Wang, 1988). However, some of the findings have suggested that the influence of self-efficacy on long-term outcomes, measured the following school year, is not significant (Holzberger et al., 2013). Our research suggests that there may be long-lasting relationships between educators' self-efficacy and their instructional beliefs. Given these positive associations, targeting educators' content-related beliefs as well as their self-efficacy to provide instruction may be dually important aims for instructors providing PD to EC educators.

**Table 3**
Latent growth curve models with TKA and TBQ as outcomes (n = 87).

| Parameters & predictors | TKA | TBQ |
|---|---|---|
| Intercept | | |
| $\gamma_{00}$ | 44.54** | 48.80** |
| $\tau_{00}$ (variance) | 39.78** | 0.88** |
| Slope | | |
| $\gamma_{10}$ | 0.23* | 0.22* |
| $\tau_{11}$ (variance) | 0.40** | 0.02** |
| Latent variable regression results | | |
| Initial Status ($\gamma_{11}$) | −1.17 | −3.13* |

Note. TKA = Teacher Knowledge Assessment of Early Language and Literacy Development; TBQ = Preschool Teacher Literacy Beliefs questionnaire. Time was measured as number of months from baseline to spring, centered at baseline. Method of estimation = full maximum likelihood. ** = significant at $p < .001$, * = significant at $p < .05$.

#### 4.2.3. Non-significant predictors of EC educators' growth and outcomes

Finally, our findings indicate that initial levels of knowledge on beliefs and initial levels of beliefs on knowledge are not significant predictors of either growth or outcomes. These findings are contrary to research and theory (e.g. Fixsen, Naoom, Blase, Friedman, & Wallace, 2005; Lin, 2013) and do not support our hypotheses. These results and their implications are described next.

Educators' initial knowledge did not predict belief outcomes, nor did initial beliefs predict knowledge outcomes. Although we had hypothesized that these characteristics would predict outcomes and growth for EC educators, for the educators in this PD, knowledge and beliefs did not relate to each other. This is an important finding that provides evidence of a new perspective in the associations between knowledge and beliefs. Namely, previous research has examined relations between knowledge and beliefs concurrently (Lin, 2013; Pajares, 1992), whereas we examined associations between the variables with respect to change over time. Our findings suggest that knowledge and beliefs may not be related when examined as a function of change over time, which may have been why we did not see the interrelation between the variables. Nonetheless, these results warrant further examination to determine whether they replicate.

## 5. Conclusions

PD provides an invaluable opportunity to enhance EC educators' knowledge and beliefs. Our findings indicate that educators can change their literacy-related knowledge and beliefs while involved in state-implemented PD programs, albeit to a small degree. Although most EC educators may only achieve minor gains, educators' outcomes can be sustained into the following school year. It

is important to note that in the present study, some EC educators participated in the state's PD, but declined participation in our research, which limits our ability to generalize the results to the entire population of the state's EC educators. Even so, our findings imply that a scaled-up version of PD implemented by non-researchers may support EC educators in obtaining knowledge and beliefs aligned with research and theory. Importantly, these findings hold for educators regardless of initial knowledge and beliefs, suggesting the potential for effective PD to benefit a wide range of educators. Moreover, the feelings of openness to change and self-efficacy brought by educators to PD may be important factors to consider, albeit future research is warranted to extend these correlational findings to determine whether these factors can actually be a causal influence on targeted outcomes of PD. Given the persistent need to support EC educators via PD, we encourage researchers to continue to explore these and other factors that may be related to the uptake of PD and the nature and extent of educators' change over time.

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