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Trajectories of Children's Writing Development in Pre-Kindergarten: Six Months of Repeated Measures

by

Kelly Marie Campbell

A dissertation submitted in partial satisfaction of the
requirements for the degree of

Doctorate of Philosophy

in

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Committee in charge:
Professor Anne E. Cunningham, Chair
Professor P. David Pearson
Professor Susan Stone

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Abstract

Trajectories of Children's Writing Development in Pre-Kindergarten:
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Early writing during pre-kindergarten is increasingly the subject of basic research and applied classroom practice. Findings from multiple disciplines highlight the role of young children's print-related skills in predicting and enhancing later literacy abilities. This growing body of research, however, lacks a refined model of writing development for this age group. Moreover, the early literacy field needs streamlined, valid assessments of writing progression from scribble lines to letters, first words, and sentences.

In this study I investigate the writing development of 62 children (ages 3 and 4) across six months in a state-funded pre-K program. The Play Plan, a daily activity from the Tools of the Mind curriculum that includes children's speech, drawing, and writing, served as the source of repeated measures. I created a synthetic, 10-point coding system (Early Writing-10; EW10) to score the continuum of early writing across an average of 16 weekly samples per child. The inter-coder agreement was excellent ($r = .94$, $p < .001$). Findings from Hierarchical Linear Modeling demonstrate that growth in early writing was substantial, highly variable, and often rapid across the 24 weeks sampled. The overall shape of the trajectory yielded significant linear, quadratic, cubic, and quartic trends. Among predictor variables, only name-writing ability, assessed at school entry, strongly predicted writing scores at the end of the investigation, but univariate analyses showed higher writing abilities for 4-year-olds than 3-year-olds. Three trajectory profiles of early writing development were categorized: slower, incremental, and rapid.

Future steps include examining the trajectory scores as predictors of subsequent literacy development, evaluating the EW10 scoring system in larger and more diverse samples, and extending it to more advanced writing development in kindergarten. I discuss implications for a developmental model of early writing and for the use of early writing assessments by researchers and educators.

Acknowledgments

The inspiration for this dissertation originates from my life-long interest in how the marks made by young children—from their first drawings to early writing—reflect their understanding of the world.

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Introduction

In what ways do young children's growing abilities in writing prior to kindergarten contribute to their later literacy skills such as decoding, spelling, composition, and comprehension? Intensive research over the last three decades has yielded greater understanding of the associations between (a) pre-reading and oral language skills and (b) later literacy achievement (Cunningham & Stanovich, 1997; Dickinson & Tabors, 2001; Hart & Risley, 1995; Lonigan, Schatschneider, & Westberg, 2008). However, far fewer studies have investigated the development of early writing, which comprises a continuum of scribble lines to the formation of letters, words, and messages during this period of foundational learning (Adi-Japha & Freeman, 2001; Clay, 2001; Ehri & Roberts, 2006; Puranik & Lonigan, 2011). Because mounting evidence suggests that early writing is a potential driver of subsequent literacy skills, increased attention is now focused on beginning writing, in particular during the pre-kindergarten (pre-K) period (Diamond, Gerde, & Powell, 2008; Molfese et al., 2011; Shickedanz & Casbergue, 2009).

Indeed, the field seems ripe for a theoretical framework delineating the development of early writing, with the need for corresponding assessments that capture both the incremental development of writing—and individual differences in writing ability among this young age group (see Puranik & Lonigan, 2014). Current evidence suggests that writing in pre-K is a generative act that stimulates development on multiple levels, including print concepts, alphabet knowledge, sound-symbol correspondence, and higher-order cognitive processes such as planning and composing (e.g., Berninger, 2000; Bodrova & Leong, 2007; Longcamp, Zerbato-Poudou, & Velay, 2004; Molfese, Beswick, Moinar, & Jacobi-Vessels, 2006; Puranik & Lonigan, 2011). Neuroscience studies demonstrate that writing facilitates growth in neural structures and networks associated with fluent reading and writing, essential even in the age of digital literacies (see James, Jao, & Berninger, 2015). In alphabetic languages (specifically English), forming lines into over forty unique characters (i.e., upper and lower case) that correspond with forty-four sounds (phonemes) requires years of practice and instruction, a rather arduous task usually completed by 2nd grade (Paris, 2005; Roskos, Christie, & Richgels, 2003;). Findings suggest such print-based skills serve as a crucial entry into the world of literacy, influencing a cascading process of knowledge acquisition during grade school and beyond (e.g., Cunningham & Stanovich, 1997; Lonigan et al., 2008). Unlocking the unique, yet complementary processes of decoding and encoding (i.e., transcribing and transforming thoughts into written language) could help in addressing the early onset of pernicious socioeconomic disparities in academic opportunity and achievement (e.g., Cabell, Justice, Konold, & McGinty, 2011; Halle et al., 2009; Snow, Burns, & Griffin, 1998).

In this dissertation, writing is defined as the "knowledge and use of symbolic representation of information, ideas, and emotions through recorded language" (California Department of Education, 2008) and includes both conceptual (i.e., the idea that print represents speech, letters represent sounds) and procedural (i.e., printing letters and words) elements. General consensus in the research literature is that early writing (also called *emergent* or *exploratory* writing) typically follows a relatively predictable developmental sequence—from scribble marks to more controlled graphic lines and shapes, to proto-letter symbols before writing a few conventional letters (often in name), and later progressing to beginning or estimated spelling of words and sentences (e.g.,

Bodrova & Leong, 2007; Gombert & Fayol, 1992; Levin, Both-de Vries, Aram, & Bus, 2005; Puranik & Lonigan, 2011). For young children, the act of writing requires an increasingly complex coordination of cognitive, language, and motoric processes influenced by individual skills and shaped by social and cultural factors (Dyson, 1987; Tolchinsky-Landsmann, 2003). Although unproductive debate continues between code-based and meaning-oriented theorists, a promising trend is toward integrating multiple approaches in understanding how to support all young learners in becoming literate members of a rapid-information society (Blair & Raver, 2014; Rowe, Miller, & Pacheco, 2014).

Currently, empirical inquiries are needed to better articulate theoretical frameworks, especially in extending the developmental model of elementary school writing by Hayes and Berninger (2009)—comprising text generation and transcription skills—down to the preschool age. Additionally, evidence-based assessments are required that sensitively capture incremental development and individual differences during the beginning phases of children's writing (see Puranik & Lonigan, 2014). This lack of a strong theoretical model and body of empirical research can be seen among measures that tap into early writing development. Indeed, only one of the five commonly used early literacy batteries includes a single procedural writing task (i.e., name writing in the Phonological Awareness Literacy Screener [PAL-S, Pre-K]; Invernizzi, Sullivan, Meier, & Swank, 2004). The other widely used assessments (e.g., Individual Growth and Development Indicators, Get Ready to Read-Revised, Test of Preschool Early Literacy, Dynamic Indicators of Beginning Early Literacy) measure phonological awareness, print concepts, alphabet knowledge, and oral language (vocabulary) but do not include a measure of writing. This omission is surprising, given that writing name/writing letters was identified as one of the top five predictors of later literacy in the National Early Literacy Panel meta-analysis (Lonigan et al., 2008). In addition to the lack of a strong theoretical model of writing development, this omission may well be related to difficulties in designing standardized measures and scoring systems for young children's writing. As one example, the range in individual names from two to twelve letters (e.g., Bo versus Margueriette) presents a problem for equitable scoring.

Indeed, valid and reliable measurements of early writing could provide vital information on children's early literacy skills, including print knowledge and phonological awareness (Clay, 2001; McBride-Chang, 1998; Richgels, 2001), necessary to inform our models of young children's writing development. For example, whether a child makes scribble marks, fills a page with proto-letters, or writes letters connected to sounds (i.e., employing the alphabetic principle) offers a snapshot into her current level of understanding the written language system. In the present dissertation study, I aim to address this gap by examining a new coding system (called "Early Writing-10" or EW10) via intensive, repeated writing samples measures over a 6-month period, in order to analyze developmental trajectories in early writing. Such a dataset is, to my knowledge, unique in the literature, and provides an unprecedented window into literacy development during the pre-K period. A primary goal of this study is to examine and compare the various trajectories of sixty-two children during this dynamic stage of learning as they begin to write first letters, words, and messages.

Conceptual Framework and Literature Review

Nearly a century ago, the Soviet neuropsychologist Alexander Luria (1929/1983) recognized that children's wavy lines drawn across a page revealed their burgeoning knowledge of written language. Decades later, the field of emergent literacy (Clay, 1975; Teale & Sulzby, 1986; Whitehurst & Lonigan, 2001), through in-depth case studies and empirical research, highlighted that writing development begins early and progresses with age and through experiences with print (Bissex, 1980, Clay, 2001; Ferriero & Teberosky, 1982; Neuman & Celano, 2001; Puranik & Lonigan, 2011). In contrast, the prevailing pedagogical assumption that writing—as the pinnacle of literacy skills—should be introduced only after children have mastered basic reading skills, appears to have limited investigations of early writing in the 20th century (Tolchinsky, 2001). Indeed, fewer than 5% of the approximately 500 studies included in the National Early Literacy Panel meta-analyses were focused on writing (Lonigan et al., 2008).

Yet growing evidence suggests that early writing (a) functions as a laboratory for children to test hypotheses in developing concepts of print (Clay, 2001); (b) builds essential code-related skills, such as alphabet knowledge and sound-symbol correspondence needed for encoding and decoding fluency (Adams, 1990; Berninger, 2000; Diamond et al., 2008; Molfese et al., 2006); (c) has a generative effect on oral language and background knowledge related to composition and comprehension (Dyson, 1982; Neuman, Roskos, Wright, & Lenhart, 2007); and (d) facilitates the development of key executive functioning skills, such as planning, attention, and memory, crucial for higher-order thinking required in school (Bodrova & Leong, 2007). Additionally, samples of children's writing are increasingly recognized as valuable assessment data reflecting a child's current level of print and oral language, of real utility for both researchers and educators (Clay, 2001; Puranik & Apel, 2010). Thus, early writing is viewed as a potential tool in narrowing disparities related to the "opportunity-achievement gap," evident before children enter kindergarten and influencing lifelong academic and career success (Halle et al., 2009; Lee & Burkam, 2002; Yoshikawa et al., 2013).

Although relatively nascent, developmental neuroscience offers insight into the underlying mechanisms in developing literacy, along with potentially valuable educational implications (Blakemore & Bunge, 2012). This emerging field, employing advanced technologies—including event-related potentials (ERP), electroencephalography (EEG), and functional magnetic resonance imaging (fMRI)—can now be used with young children, offering unprecedented examination of neural processes (i.e., formerly inside the "black box"; see review by Kuhl, 2011). Neuroimaging studies indicate that numerous brain regions, in particular the fusiform gyrus and the parietal cortex, are activated as children and adults write letters and words. These networks develop over time in response to writing and literacy experiences to function more bilaterally in skilled writers (see Giminez et al., 2014). Moreover, findings suggest that the sensorimotor act of writing improves letter perception and recall needed for fluency to a greater extent than typing, tracing, or word reading (Berninger, 2000; James, 2010; Longcamp et al., 2004). Based on fMRI data with small samples of children in the early grades, researchers contend that writing by hand "…facilitated an internal model of the letter due to integration of vision, motor commands, and kinesthetic feedback" (Kersey & James, 2013, p. 1).

Thus, it appears that handwriting helps children in distinguishing the particular attributes of each individual letter, essential for both beginning and writing. Additionally, the intensive letter-to-letter processing required by printing may support the development of orthographic knowledge (spelling) at the morpheme and word level, crucial to master in the early grades (Ouellette & Senechal, 2008). Significantly, these lower-order transcription skills (e.g., handwriting and beginning spelling) are associated with later composition skills, as well as reading comprehension abilities (Berninger et al., 2006; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997). Evidence suggests that these early processes of becoming "symbol-minded" by using alphabet letters to spell words and write first messages at age 5 may contribute to cumulative literacy abilities that influence composing an academic essay in high school or university (Bialystock & Martin, 2003; DeLoache, 2004, Gimenez et al., 2015).

The Need for Measures of Writing

Currently, there is no standardized format or valid measure of children's early writing before kindergarten (Puranik & Lonigan, 2014). As stated previously, early writing is largely absent from "comprehensive" early literacy batteries. Devising a common writing task that is developmentally sensitive, plus a reliable scoring system for the production of writing at this age, has proven difficult in empirical studies (see "Sentence Retell" task of Puranik & Lonigan, 2011). Most existing measures used in research have been investigator-designed and largely adapted from kindergarten or grade school tasks. In my own experience in conducting early literacy assessments for research projects, I was struck by the absence of young children's writing production as a missed opportunity for examining their "applied" knowledge of print. This prompted my interest in collecting and analyzing such data for my final position paper.

To gain understanding of the procedures and methods that might assist in developing such an assessment tool, I searched through relevant research and curricula. In-depth case studies and observational research provided a wealth of insight into the continuum of children's first scribble marks and letters progressing to estimated spelling and more conventional writing skills (e.g., Baghban, 2007; Bissex, 1980; Clay, 1975, 2001; Dyson, 1982; Ferreiro & Teberosky, 1982; Gombert & Fayol, 1992). However, from these sources, one could surmise that early writing emerged rather spontaneously and idiosyncratically. Aside from name writing, there seemed to be no consistent means of documenting children's growth. I found one notable exception in the literature: the Play Plan from the Tools of the Mind (TOM) pre-K curriculum (Bodrova & Leong, 2007). The dramatic growth in symbolic competencies, both drawing and writing, was evident across one child's Play Plans from fall, winter, and spring (Bodrova & Leong, 2001). A basic growth curve, drawn from connecting these three data points, inspired me to use the Play Plan as a repeated measure to investigate pre-K children's writing development for my dissertation study.

The Play Plan itself is a sheet of paper on which a child works with a trained teacher to record planful speech, drawing, and writing in describing her intended activity for the dramatic play period (see examples in Appendix A). The sheet is divided into three main areas from top to bottom: writing name, drawing a picture, and composing a message beginning with the prompt: "I am going to…". As a daily early literacy practice within the

larger Scaffolded Writing program in TOM, the Play Plan offers a flexible format designed to engage 3- and 4-year-old children at any point across the "scribbles to spelling" continuum. Teachers also encourage children to "read" aloud the previous day's Play Plan before beginning a new one. Thus, the TOM Play Plan integrates multiple symbolic systems, including language, pictures, and literacy, as well as key executive functioning skills (e.g., planning, memory, and attention).

The Role of Name Writing

Writing one's given name, a meaningful word frequently heard and seen as a stable string of letters in print, is recognized as a landmark achievement on the path toward conventional literacy (Bloodgood, 1999; Hildreth, 1936; Levin et al., 2005; Lonigan et al., 2008; Villaume & Wilson, 1989; Welsch, Sullivan, & Justice, 2003). Name writing requires coordination of multiple cognitive and motoric abilities, such as memory of specific letter shapes in correct sequence and the motor skills needed to print legible letters on a horizontal line (Berninger et al., 2006; Longcamp et al., 2004). Overall, within literate societies, findings reveal significant age-related progressions in 3- to 5-year-olds' abilities to write their names (e.g., Ferreiro & Teberosky, 1982; Hildreth, 1936; Lieberman, 1985; Levin et al., 2005; Welsch et al., 2003).

Prior research has associated name-writing ability with print knowledge (Clay, 1975; Teale & Sulzby, 1986). Additionally, strong correlations, ranging from .55 to .77, have been found between proficient name writing and letter or alphabet knowledge (e.g., Bloodgood, 1999; Ho, 2011; Puranik & Lonigan, 2011; Welsch et al., 2003). Few studies have corroborated Blair and Savage's (2006) finding of a relation between name writing and phonological awareness. Several authors conclude that advanced name-writers outperformed less advanced name-writers in nearly every early literacy task (e.g., Welsch et al., 2003; Bloodgood, 1999), a finding echoed more recently by Puranik and Lonigan (2012) in their large sample of mixed-SES preschoolers (N = 372).

Although the ability to write one's name clearly reflects a certain level of symbolic understanding and procedural or motor skill, several studies demonstrate the constraints related to this knowledge. As one example, Both de-Vries and Bus (2010) found that among preschoolers in their study who could write their name, 80% were able to correctly identify the initial letter (e.g., "J" is for Jenny) compared to only 37% regarding the second letter. Additional findings support the claim that writing one's first name does not necessarily reflect complete alphabet knowledge or letter-sound correspondence (e.g., Drouin & Harmon, 2009; Villaume & Wilson, 1989).

Thus, it appears that the name may be originally memorized as a complete sign, logogram, or first "sight word" in a child's emerging literacy skill. Still, the letters in a child's first name appear to provide a personalized and valuable (albeit limited) pool, serving as an entry into the alphabet and a general stepping-stone into the world of print (Both de-Vries & Bus, 2010; Justice, Pence, Bowles, & Wiggins, 2006; Puranik & Lonigan, 2011). In this dissertation study, I examine children's name writing ability at the beginning of pre-K as a predictor of the development of more general early writing skills.

Writing Letters into Words

Examinations of early or emergent writing include name writing, letter writing, and beginning spelling. Findings noted above suggest that if name writing reflects general print knowledge, then the ability to write letters into first words may be a better indicator of the alphabetic principle—i.e., the consistent mapping of phonemes to graphemes (Ehri, 2000; Fayol, Alamargot, & Berninger, 2012). Indeed, increasing attention is focused on the early literacy milestone of invented spelling as a complex developmental skill that can begin in preschool (e.g., Puranik, Lonigan, & Kim, 2011).

Learning to write the letters of the alphabet is one component skill of beginning spelling. Findings suggest a relation between the ability to write letters of the alphabet, sometimes measured in assessments such as timed tasks, and later spelling (e.g., Berninger, 2000). Automaticity of this lower-order transcription skill seems to reflect alphabet knowledge, requiring rapid access of symbolic representations stored in memory in coordination with fine motor skills (Berninger et al., 2006; Graham, Harris, & Fink, 2000). Puranik et al. (2011) reported that letter-writing skills made a significant independent contribution to the prediction of spelling in a study of 296 preschool children aged 4-5 years. However, in order to begin sounding out first words to spell, children must integrate their letter-writing skills with a host of other abilities, including print knowledge, the alphabetic principle, phonological awareness, oral language, and burgeoning orthographic processing (McBride-Chang, 1998; Moats, 2006).

Studies demonstrate that writing letters, words, and messages in preschool, as exemplified by the Tools of the Mind curriculum, has a bidirectional effect on other early literacy skills, such as alphabet knowledge, forms and functions of print, and phonological awareness (e.g., Diamond et al., 2008). The act of writing focuses children on print, allows practice in attending to the specific features of individual letters, applying letter-sound relations, and developing word analytic skills (Justice et al., 2006). In sum, this active engagement in communicating meaningful messages appears to build capacity in the code-related skills necessary for both beginning spelling and decoding (Adams, 1990; Ouellette & Senechal, 2008; Read & Treiman, 2012; Richgels, 2001).

Additionally, "automaticity" of lower-order transcription skills (e.g., the ability to write letters and spell words at a competent level without requiring conscious effort) in the early grades is associated with later advanced composition abilities, highlighting the value of the activity referred to as "language by hand" by Berninger et al. (2006). Currently, investigations examining estimated spelling are needed, building on earlier experimental work, including Clarke's (1988) finding that 1st graders encouraged to use invented spelling, as compared with traditional spelling, wrote longer and more elaborate stories. Longitudinal studies using repeated measures, such as TOM Play Plans, could provide insight into even earlier writing development.

Study Goals

A theory-based and empirically tested scoring system for early writing could help fill a major gap in the existing literature: Namely, the lack of information on pre-K children's trajectories of writing development. It may be that the kinds of progress in early writing made by children not only provide clues to their cognitive and literacy

development, but may ultimately predict their abilities in reading, which is well-documented in studies starting in grade school (e.g., Graham & Hebert, 2010; Juel, 1988).

In sum, the goals of this dissertation are to examine the reliability and validity of a newly synthesized 10-point scoring metric related to pre-K children's early writing, to examine trajectories of writing development via intensive repeated measures during the first six months of pre-K, and to predict such trajectories from initial name-writing abilities as well as demographic factors.

Hypotheses

From the present longitudinal study utilizing intensive repeated measures of early writing, I predict the following:

1) Wide variability will be evident in the early writing performance of participants across the first 6 months of pre-K, especially between 3- and 4-year-olds. In addition, I predict that the overall trajectory of growth in writing will show a step-like progression, whereby gains will be followed by plateaus.

2) Four predictor variables—gender, age, number of years in the TOM program (first vs. second year), and name-writing score at school entry—will each explain significant variance in final writing scores. I predict that name writing will yield the strongest effect.

3) Preliminary evidence for subgroups will be found in differing trajectory patterns of the sample. I predict to find three general profiles: low, medium, and high.

Method

Participants

Sixty-two (N = 62) 3- and 4-year-old children attending a pre-K center in a suburb of a Western city in the United States served as participants in this study. The center offers a half-day program and utilizes the TOM curriculum, led by two co-teachers in each of the three classrooms. An original total of 87 children were enrolled, but the following inclusion and criteria were applied. First, children had to begin the program during the fall (September through November 2015) and have at least 13 writing samples—i.e., Play Plans—between the fall and winter, to allow for multiple repeated measures and trajectory analysis. Five children did not meet these criteria. Second, I excluded those 20 children who had an Individual Educational Plan (IEP), based on information from the site director.

The final sample of 62 children ranged in age from 36-58 months (M = 49 months) at school entry in September. The sample was composed of 20 3-year-olds and 42 4-year-olds, with an even gender split of 31 males and 31 females. Of the 62 participants, 40 (63%) were in their first year of pre-K at this center, and 22 (37%) were enrolled in their second year. The estimate of ethnicity/race distribution, from center director reports, is as follows: White = 63%; Hispanic = 25%; Asian American = 10%, and Native American = < 2%.

The pre-K site consists of three portable classrooms, attached to an elementary school; it primarily serves working families. According to the director, the center receives state funding but just misses qualifying for federal Title 1 funds.

The six pre-K teachers, all White females, have participated in the TOM professional development program on average for eight years. Three have eighteen-plus years of teaching experience, with ten years at this particular center. Notably, this level of

employment stability differs from national trends reporting high turnover rates in this low-paying profession. In terms of education, one teacher had a high-school diploma, one a Bachelor of Arts degree, and the remaining four teachers had the minimum 12 community college units in Early Childhood Education.

All parents/guardians signed permission forms for their children to participate in regular data collection with the TOM program at this center. Staff of the TOM project created a de-identified coding system by replacing names with numbers in order to protect confidentiality. As a result, this study of an existing curricular practice received "exempt" status from the Committee for Protection of Human Subjects at UC Berkeley. Note that the "exempt" nature of this investigation precluded gaining additional subject-level demographic information.

Procedure

Study data were 1144 writing samples in the form of Play Plans, a daily TOM pre-K activity in which children plan, draw, and "write" a message about their dramatic play choice on a sheet of paper (see Appendix A for examples). Developed by co-creators Drs. Elena Bodrova and Deborah J. Leong (1997, 2007), Play Plans are one of six early-literacy activities within the scaffolded writing program, comprising one of the few existing techniques for early writing recommended by the International Literacy Association. The process is as follows: After circle time, children sit in a small group (4-6) at a table with a teacher or aide. Each child chooses a dramatic play area for center time (e.g., home, restaurant, veterinary hospital). Using the stem, "I am going to…," each child says aloud her intended role. Next, she draws a picture of the planned play activity and then "writes" her oral message about the activity. For children at the pre-alphabet level of writing development, scribble marks, lines, and shapes may be written. Children finish by writing their name across the top of the paper before leaving the table to engage in the subsequent dramatic play activity. Each Play Plan is dated.

Teachers (who receive over 20 hours of professional development in the TOM early literacy curriculum) employ scaffolded writing techniques and principles to assess and then guide the child's current level to the next (i.e., Zone of Proximal Development; see Vygotsky, 1962). Teachers indicate both the child's completely independent level, as well as the scaffolded level (i.e., with teacher's help) at the top of the Play Plan. Writing samples with indications of very high teacher support (e.g., teacher uses hand-over-hand to write with child) were excluded from this study, as were Play Plans without clear dates. Additional curricular scaffolds include a name card for each child and an original TOM Sound Map linking high-utility letters with pictures representing the letter sounds.

As this study is focused on writing development, I limit my investigation to the message or sentence component (i.e., the lower portion of the Play Plan), comprising the dependent measure of early writing. I include the child's initial name-writing score at school entry as predictor in the analyses. Analysis of drawings, and their possible associations with early writing and concept development, will be subject to future investigation.

The data for this study consist of writing samples collected each week from the beginning of the 2015-6 school year until March 2016. To familiarize myself with the TOM Play Plan procedures, I informally observed teacher-child Play Plan practices in each of

these three classrooms, as well as multiple other sites during the academic year. This particular center was selected for the study by co-developer of TOM, Dr. Elena Bodrova, with the assistance a lead professional development trainer, who both indicated that the center showed "high fidelity" with respect to TOM implementation. The three classrooms received $60 in gift cards for books, and the site director received a $40 gift card for her generous assistance in collecting the samples.

Measures

A. Name Writing. Although no standardized system is currently recognized in the literature, the Simple Scoring Rubric (SSR) was found to be equally valid to other, far more complex scoring methods by Puranik, Schreiber, Estabrook, and O'Donnell (2013). Scoring on their 5-level measure is as follows: 0) scribble; 1) writing contains simple or complex forms (squares, circles, etc.); 2) writing contains first letter of name or a recognizable letter; 3) writing contains many letters of name; 4) writes name using conventional spelling. After several rounds of preliminary coding, I revised the SSR to comprise a slightly modified 6-point scale: 0) no attempt; 1) scribble marks; 2) simple or complex forms; 3) one or two letters of name; 4) several letters of name; and 5) all letters of name on a horizontal line.

B. Early Writing. Reflecting consensus in the field, Puranik and Lonigan (2014) note that there is no standardized measure for scoring emerging writing. A key goal for this dissertation study was to create a 10-point pre-K scoring system from several sources. I considered prior literature on early writing development (e.g., Clay, 1975; Ferreiro & Teberosky, 1982; Fayol & Gombert, 1992), models of spelling development (Ehri, 2000; Justice & Vukelich, 2007), invented spelling research (Read & Trieman, 2012; Richgels, 2001; Oullette & Senechal, 2008), as well as recent models and matrices (e.g., Rowe & Wilson, 2009). In general, the literature suggests a general trend from scribble marks to drawing, followed by letter writing, eventually progressing to letter-sound correspondence (i.e., early spelling) abilities. Justice and Vukelich (2007) assert that orthographic development proceeds in five general stages: (1) drawing/scribbling; (2) letters/letter-like units; (3) beginning stages of invented spelling; (4) later stages of invented spelling; and (5) conventional spelling. I based my synthetic, 10-point coding scheme early on this hypothesized continuum.

The comprehensive "Write Start!" assessment by Rowe and Wilson (2009) consists of 32 levels to measure the early writing of 2- to 6-year-olds. The descriptive categories include writing form, directionality, intentionality, and message content. I also examined the extensive TOM Play Plan Coding Rules (Bodrova & Leong, 2011), comprising forty-one items spanning five categories of early writing (Name, Message, Sight words, Words, and Teacher scaffolding). Teachers assess the message area of the Play Plan for the following evidence: correct number of lines that represent words, letter-like marks, legible letters, capital and lower case, words and spaces, punctuation marks, plus sight words (I, am, going, to) and correct use of phonemes in spelling words. Although these systems provide a multi-dimensional, in-depth view of children's writing, I deemed both systems to be highly complex and potentially unreliable for wide use. Additionally, neither one has been empirically validated.

I analyzed a previous sample of over 200 TOM Play Plans from three pre-K classrooms and one kindergarten classroom collected at three time points during the 2014-2015 school year. These provided valuable information for the creation of my initial scoring system. After a pilot round, I deleted a level of "sight words" because of low base rates. I also altered the "estimated spelling" levels to exclude the fine-grained categories of beginning, medial, and final sounds to reflect a more ratio-based system of 1) beginning letter-sound correspondence; 2) medium letter-sound correspondence; and 3) estimated spelling. The final system includes ten levels to account for more advanced examples toward conventional spelling. For capturing the expanded writing skills of kindergarteners, extensions with additional levels will be required. See Table 1 for definitions and examples of each level of this Early Writing-10 (EW10) scoring system.

Inter-scorer agreement

I trained a doctoral-level colleague in both scoring systems. First, for name-writing skills, the coder independently scored a random 39 of the name-writing samples using the revised SSR metric of 0-5 points. We reached exact agreement on 33 of the 39 samples (85%), signifying excellent agreement. The Pearson correlation between our scores was $r = .91$, $p < .001$, also signifying excellent agreement. No disagreement was more than 1 point. The scores of the senior coder (the author) were used in all subsequent analyses.

Second, for the EW10, the second coder independently scored 40% of the early writing samples across the 24 weeks of the investigation. To ensure blindness to the main hypotheses of the study, related to growth in early writing, writing samples were randomly ordered and all reference to date of assessment was deleted from the Play Plans. Among these writing samples, the exact agreement was 76%, revealing good to excellent agreement. Of the 106 disagreements, 95 were one point off; the remaining 11 were no more than 2 points off. The Pearson correlation between the scores of the senior coder and the reliability coder was $r = .94$, $p < .001$, signifying an extremely high level of agreement. Whenever possible, disagreements were resolved by consensus scoring between the two coders. In all other cases, the author's score was entered into all subsequent analyses.

Data Analysis

A maxim within developmental psychology states that ideally, investigators should measure the phenomenon of interest frequently during periods of rapid growth. In this longitudinal investigation of children's writing during the initial six months in pre-K, I utilized both descriptive and inferential statistics to examine change across intensive repeated measures of writing development.

I first present a number of descriptive statistics related to the repeated measures collected for this study.

Next, for Hypothesis 1, regarding variability, independent-samples t-tests were performed with the independent variable of age (3- vs. 4-years of age) with respect to EW10 scores (specifically, each child's initial writing sample, final writing sample, and highest-scoring writing sample across the 24 weeks). I also tested, within 4-year-olds, whether the year of participation in the Tools of the Mind program (children's first vs. second year) influenced these scores.

To examine Hypothesis 2, formal tests utilizing hierarchical linear modeling (HLM), specifically growth curve modeling, were conducted. This statistical procedure is indicated for the analysis of grouped (or nested) data and is useful for capturing trajectories of development. Level 1 (week) was the time-varying variable; Level 2 variables were participant characteristics age, gender, years of participation in the TOM program (i.e., first vs. second year at the school), and the score for name writing ability at school entry. HLM is indicated for the analysis of nested data "because it identifies the relationship between predictor and outcome variables, by taking both Level 1 and Level 2 regression relationships into account" (Woltman, Feldstain, MacKay, & Rocchi, 2012, p. 56). To model non-linear growth, a polynomial model was used to test the growth trajectories. Initially, the intraclass correlation of the variance-component model was calculated to verify the nested structure of the data. Each subsequent HLM was evaluated for model fit with Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and coefficients of determination statistics. To test the Level 1 variable of week, exponential variables were entered into the model (i.e., the linear, quadratic, cubic, and quartic powers of week).

For Hypothesis 2, all Level-2 variables (e.g., child's gender, age, years of participation in the TOM program, and name writing at school entry) were included in the model, in addition to week (Level 1).

Hypothesis 3 involves the search for specific defining characteristics or parameters to describe the different patterns of change present among the 62 trajectories. I include entry scores and an analysis of slopes (rates and time points) in order to define these possible "profiles." That is, the relatively small sample size of participants prevented a cluster analysis to reveal inherent subgroups. I therefore examined rates of initial and final change to pre-specify a subgroup with a relatively low rate of growth, one with an incremental rate of growth, and one characterized by a rapid rate of growth.

Results

Descriptive Findings

Across the first 24 weeks of the 2015-2016 school year, from the beginning of September through the first week of March, the 62 participants averaged 16 valid weekly Play Plans (range = 13 to 22). Three of these participants did not start the school year until November. Missing data included (a) child's absence from school during a given week, (b) the teacher's indication of extremely high scaffolding for a given Play Plan, or (c) no mark-making or writing in the message area of the Play Plan for a given week. Of the total 1144 Play Plans, 153 observations (13%) were coded as missing, the vast majority of which were for child absences or non-attempted writing. Nonetheless, the data still provide an unprecedented examination of repeated measures of early writing development.

At the start of the school year, the participants' mean score for their first attempted Play Plan was 1.1 (SD = 1.5), indicating random scribble marks. Six months later, in the final week of data collection, the average score had increased to 3.9 (SD = 1.8), representing one or two letters written. The mean highest score for participants (at any time during data collection) averaged 4.9 (SD = 1.4), representing three or more letters written. Thus, on average, children demonstrated extremely low levels of writing ability at school entry and, six months later, over the 24 weeks of scaffolded writing practice and instruction,

progressed to a level of letter writing, as scored by the EW10. Individual gains ranged from one to seven points, with only one child's scores staying relatively flat.

Figure 1 displays a plot of the average trajectory of writing development for the 62 participants, across the 24 weeks of the study. Appendix B displays the individual writing development plots for each of the 62 participants.

Hypothesis 1

Wide variability will be evident in the early writing performance of participants across the first 6 months of pre-K, especially between 3- and 4-year-olds. In addition, I predict that the overall trajectory of growth in writing will show a step-like progression, whereby gains will be followed by plateaus.

Wide variability among participants was evident at all time points across the 24-week span of the study. Specifically, during the first week of each participant's data collection, EW10 scores ranged from 0-6—that is, from no attempted writing to the writing of letters corresponding to initial sounds. During the final week, scores ranged from 1-8, from random lines to medium-level letter-sound correspondence. In sum, despite the appearance of linear progression across the sample (see Figure 1 and hypothesis testing below), the sample's writing scores were in fact extremely variable across the 24-week investigation.

To investigate age-related differences in this sample, I created two age categories of participants, based on the categorizations used at the school program: (a) 3-year-olds (36 to 44 months at entry) and (b) 4-year-olds (45 to 58 months at entry). The school's rationale was to divide the sample into ages 3 vs. 4 years of age by the end of December. I analyzed three scores for each participant: the first, the final, and highest score attained between September and early March.

At school entry, differences in the writing performance of 3-year-olds (n = 20) and 4-year-olds (n = 42) were evident. Four-year-olds had higher initial scores (M = 1.45, SD = 1.67) than 3-year-olds (M = 0.40, SD = 0.75), $t(60) = 2.68$, $p < .01$. All 20 of the 3-year-olds' scores ranged from 0 to 2 on the first Play Plan, with 75% scoring at 0. Scores for the 4-year-olds (n=42) demonstrated a much wider spread (0 to 6), with 48% scoring at 0. Interestingly, this same wide spread was seen in the scores of the twelve oldest participants (all 57-58 months of age). Some letter-writing ability (i.e., a score of 4 or higher on the EW10) was demonstrated by five of the 4-year-olds (12%) in their first Play Plan. Indeed, one boy (57 months at entry), in his second year of TOM curriculum, wrote five letters: I-M-G-T-P, corresponding to his oral message of "I am going to play with cars and build a house and fix stuff," to yield the highest entry score of 6 (indicating initial letter-sound correspondence) in the entire sample.

By March, for the final writing score after 24 weeks of scaffolded writing experiences, 4-year-olds also had higher average scores (M = 4.75, SD = 1.41), vs. 3-year-olds (M = 2.45, SD =1.63), $t(60) = 5,64$, $p < .001$. The range for 4-year-olds remained higher (2-8) than that of the 3-year-olds (0-5).

Of note, a number of children attained their highest writing scores before the final Play Plan. Analyzing these "highest scores," I found that 4-year-olds again showed higher averages (M = 5.55, SD = 1.18) than 3-year-olds (M = 3.65, SD = 0.75), $t(58) = 6.58$, $p < .001$. Here, 95% of 4-year-olds reached a level of letter writing (4 or higher) and over half

(52%) showed at least some letter-sound correspondence (6 or higher). One 4-year old girl, who entered with a score of 4, attained a high score of 8, reflecting the level of estimated spelling via her message, "I am going to get a dog." In contrast, none of the 3-year-olds reached the level of letter-sound correspondence, even with their highest scores.

For the final part of Hypothesis 1, to test for the shape of the growth trajectory across the 24 weeks, HLM analyses were conducted, as described in the Data Analysis section. Beforehand, an intercept-only model revealed that the intra-class coefficient (ICC) was .44 ($p < .001$), signifying that 44% of the variance in final EW10 scores was due to variation between participants, confirming heterogeneity between participants. This allowed for further HLM tests of both week (shape of growth curve) and participant-level variables (i.e., predictors).

To test the significance of time trends in the growth-curve model, the Level 1 variable of week (linear), along with the quadratic, cubic, and quartic functions of week, were entered. The fit of the model with all four exponents (BIC= 2570) was a lower value than when only linear, quadratic, and cubic exponents were included. As can be seen in Table 2, the linear effect of week was significant ($p < .001$), but so were the quadratic ($p < .001$), cubic ($p = .001$), and quartic components ($p < .001$). Notably, the quadratic and quartic coefficients were negative, indicating an inverted-U shape to the function, but the linear and cubic coefficients were positive, demonstrating overall growth in writing across the 6-month period. Thus, as indicated in Figure 1, the general pattern reveals overall progress in EW10 scores (linear trend), with a gradual tapering of progress (quadratic and quartic trends, each with a negative slope), yet some evidence of additional progress after an initial plateauing (cubic trend). I did not find overall evidence for a step-function of gains followed by plateaus, but the individual growth curves do reveal gains followed by periods of leveling off, perhaps revealing consolidation of early writing skills.

Hypothesis 2

Four predictor variables—gender, age, number of years in Tools of the Mind program (first vs. second year), and name-writing score at school entry—will each explain significant variance in final writing scores. I predict that name writing will yield the strongest effect.

To test predictors, the variables of gender, age, number of years in TOM program, and name-writing score at study entry were entered into the basic model following the linear, quadratic, cubic, and quartic coefficients of week. See Table 2.

The effects of gender ($p > .10$), participant age ($p > .5$), and number of years within the program ($p < .08$) were not statistically significant, but the effect of name-writing ability at school entry was significant ($p < .001$). Indeed, results indicated that for every point of increase in entry name-writing scores, the final early writing score increased by .35 points.

Although the HLM results indicated a non-significant effect for years in the TOM program, a univariate analysis was conducted to examine possible differences in the early writing performances of 4-year-old children in either their first ($n = 17$) versus second year of the program ($n = 25$). Results from the independent samples t-test revealed a significant difference in participant's writing scores at school entry: M (Year 2) = 2.0 (SD = 1.76), vs. M (Year 1) = 0.65 (SD = 1.17), $t(40)=2.78$, $p < .01$. Thus, in this sample, scores for children entering their second year in the TOM program were on average higher. Yet the difference

between these two groups with respect to final writing scores was non-significant ($p > .05$).

In order to probe the effect of name writing as a predictor, I created two categories, based on the revised Simple Scoring Rubric. A "lower skill" name writing (LSNW) group referred to participants with scores of 0 to 2 (no or non-letter marks) and a "higher skill" name writing (HSNW) for those with scores of 3 to 5 (one, many, or all letters of name). At school entry, 29 children (47%) were in the LSNW group and 33 children (53%) were in the HSNW group. Note that only three of the 20 (15%) 3-year-olds were in the HSNW group, compared to 30/42 (71%) of the 4-year-olds.

Children in the HSNW group had far higher final EW10 scores than those in the LSNW group, $t(60) = 5.81$, $p < .001$. The same effect was found for the participant's EW10 "highest" score, $t(60) = 5.93$, $p < .001$.

To illustrate these differences, 93% (31/33) of the HSNW group reached a 4 (letter level) or higher on final scores compared to 34% (10/29) of those in the LSNW group. Most significantly, ten of the eleven participants (91%) who reached the "initial sounds" level (6 or higher) in their final score were in the HSNW group. Results indicate a similar pattern with name writing at entry and the highest scores during the study. In contrast to these associated gains, two participants, both aged 58 months at entry and in their second year of TOM, could write several letters in their names at entry (4 on the modified SSR), yet their EW10 final scores were 3 and high scores were 4. Additionally, all three of the 3-year-olds who could write one letter of their name at entry also finished with EW10 scores of 3 or 4.

Hypothesis 3

Preliminary evidence for subgroups will be found in differing trajectory patterns of the sample. I predict to find three general profiles: low, medium, and high.

Somewhat different from my prediction of three general profiles of low, medium and high, an examination of the 62 individual trajectories (see Appendix B) revealed trends in terms of different starting and ending points, slopes, and rates of growth. Some children started low and ended relatively low in terms of writing development; others started low but made steady progress; and still others seemed to ascend quickly and finish with rather high skill levels. In order to describe these general patterns, I applied the following criteria to create three profiles of growth in early writing: 1) *slower* progression (plateau around an EW10 score of 2 or 3; final score of 4 or lower); 2) *incremental* (steady progression across weeks; total increase of around +5 points); and 3) *rapid rise* (steep initial increase to finish near a score of 6 of higher). A fourth category, "low-medium," failed to capture any participants and was thus discarded.

These subgroups were derived from an examination of scores and slopes, rather than via a formal cluster analysis, as there were too few participants for the latter. Nonetheless, the third and final hypothesis was examined by conducting a one-level growth curve model in HLM with no mixed effect. Based on the parameters described above, results indicated the following: 48% of participants met criteria for *slower progression* (n = 30); 34% for *incremental* (n = 21); and 18% for *rapid rise* (n = 11). Figure 2 displays the fitted trajectories for each subgroup, as well as the average.

At first glance, the slower trajectory group is the largest, yet the vast majority of 3-year-olds (19/20) are represented here: only 6/20 (30%) of 3-year-olds reached a final

score above a 3 (i.e., a 4 or 5). If only 4-year-olds are considered, the incremental group becomes the largest (n = 20), with the remaining participants split evenly between the slower progression (n = 11) and rapid rise (n = 11) groups. Within the rapid-rise group, 8 of 11 participants (73%) were in their second year of TOM. Although all three groups displayed an initial increase during the first five weeks, the rapid rise group was distinguished by reaching a score of 4 (letter level) by Week 3. In contrast, the slower progression group reached 2 at this time point and stayed between a score of 2 and 3 for approximately 18 weeks, honing the ability to draw controlled lines representing words in their messages (i.e., speech to print).

Discussion

In this unprecedented, repeated measures investigation of early writing development among 62 children across the first six months in pre-K, the two key findings were that (a) highly reliable scores emerged from my development of the EW10 scoring system and (b) an overall growth trajectory emerged across the participants. Despite large variability across participants at each time point, there was overall growth in early writing scores, consistent with a linear trend. There was also evidence for a second spike of growth after an initial leveling, consistent with a cubic trend, as well a slight tendency for tapering in the latter weeks of data collection, consistent with quadratic or quartic functions. In addition, results from HLM analyses demonstrated that name-writing score at entry significantly predicted final scores on the EW10, but no significant prediction was found for gender, age, or years in the TOM program, when all of these variables were considered simultaneously. However, univariate analyses revealed significant mean differences between the writing scores of 3 vs. 4 year olds across the time span of the investigation, as well as higher school-entry writing scores for 4-year-old children starting their second year in the TOM program. Overall, gains in early writing during the first 6 months of pre-K were readily apparent.

In the TOM program utilizing scaffolded writing techniques, young children's overall development in early writing skills was often fast and furious, as seen in Figure 1. The overall trajectory, with its steep initial rise followed by various peaks and valleys, suggests bursts of learning followed by periods of consolidation, a common trend in longitudinal education research (e.g., Dawson-Tunik, Commons, Wilson, & Fischer, 2005). Compared to typical studies with at most two or three time points, these data—with an average of 16 data points per participant—provide a far more nuanced portrayal of growth. This intensive, repeated-measures design offered a unique window into unfolding writing skills, as children began to draw lines into recognizable letters and begin to spell words.

Embedded within the overall trajectory of writing development, the 62 individual arcs displayed substantial variability (see Appendix B). Univariate t-tests revealed that 4-year-olds made larger gains, on average, than 3-year-olds, whose writing tended to plateau, with their final scores not rising above 4 (i.e., one or two letters). Indeed, age-related differences in the progression of early writing are well documented (Hildreth, 1936; Lieberman, 1985; Puranik & Lonigan, 2011). As expected, younger children focused on drawing and name writing in their Play Plans, exploring print (e.g., print represents speech, left-to-right orientation), whereas the older children demonstrated consolidation of more advanced letter-writing skills.

In addition to age, experience with the TOM curriculum also provided an advantage. The higher school-entry scores of 4-year-olds in their second year of the TOM program are likely to reflect the advantage of increased familiarity with the Play Plan format—as well as up to a year of scaffolded writing experiences and instruction. Yet final writing scores did not differ significantly depending on first versus second year in the program, suggesting that the TOM curriculum has the potential to propel or accelerate young children's writing during one year of pre-K. However, a much larger sample size is needed to explore this potential finding further.

Contrary to findings demonstrating an advantage for girls over boys in early writing skills (e.g., Puranik, Petscher, & Lonigan, 2014), the present results did not indicate a significant gender difference. Certainly, the small sample size limited statistical power to detect any gender differences. Alternatively, by ages 3 and 4, it is possible that a structured writing curriculum dampens girls' faster developmental progressions in language and pre-literacy, which are evident within the first years of life.

The association found between name-writing ability at school entry and final EW10 writing scores in this sample is consistent with several major studies that attest to the predictive ability of early name-writing skills (see Bloodgood, 1999, Lieberman, 1985; Puranik et al., 2011; Villaume & Wilson, 1989). For example, the NELP meta-analysis revealed that name writing moderately correlates with later spelling (r = .33). Welsch et al. (2003) concluded that stronger name writers performed higher on all other literacy measures (including word writing). Indeed, writing the letters in one's name and writing words reflects shared abilities in print knowledge and fine motor coordination (Diamond et al., 2008). However, although a majority (66%) of those in the HSNW group reached the top scores of 6 to 8 (letter-sound correspondence), a full one-third of this group remained at the random-letter level (4 or 5). Clearly, name-writing ability does not automatically transfer to beginning spelling, which requires a much broader and deeper knowledge of the alphabetic principle (i.e., connecting grapheme to phoneme; see Puranik et al., 2011). This fact was evident in message-writing samples of at least three children who drew exclusively upon letters of their name (e.g., Treiman, Kessler, & Bourassa, 2001). For example, one child's oral message "I am going to get a puppy" was written with 15 letters all repeated from her name (Lila), indicating random letter strings (an EW10 score of 5). Certainly, the early education tradition of limiting writing to children's names needs to be expanded, in order to prepare for kindergarten.

Preliminary findings regarding Hypothesis 3 suggest support for the presence of differing trajectory profiles of writing development within this sample. Previous cross-sectional studies utilizing profile analysis in examining early literacy skills have identified characteristics of varying subgroups (e.g., Cabell et al., 2009; Welsch et al., 2003). The three categories of growth described in this study—slower, incremental, and rapid rise—appear to reflect differing patterns of writing development. My analysis constrained the trajectory profiles based on my observations of individual growth curves. In the future, a traditional growth curve analysis using larger-scale, longitudinal dataset could provide useful information to create curricula and strategies that better tailor or target instruction in early writing for diverse learners.

Implications

One of the primary goals of this investigation was to examine the early writing growth possible during the first six months of pre-K. Granted, beginning to write is a demanding, complex task for young children involving a dynamic integration or "orchestration" of cognitive, language, motor, and interpersonal abilities (Dyson, 1987). Yet there is also excitement and a sense of power as children begin breaking the written language code to communicate ideas, information, and feelings (Roskos et al, 2003). TOM Play Plans specifically, and scaffolded writing techniques more generally, appear to offer a consistent, developmentally-sensitive structure for children to explore, practice, and gain mastery of essential print skills (e.g., concepts of print, alphabet knowledge, phonological awareness, letter-sound correspondence, letter writing, as well as oral language). Indeed, in this sample, 61% of 4-year-olds reached a score of 6 on the EW10, reflecting the ability to write "initial sounds," the precursor to begin spelling and decoding words. Thus, these children are developing the first keys to enter the world of words, books, and knowledge crucial for academic learning.

Given that an estimated half of children in the U.S. enter kindergarten without basic levels of "school readiness" skills, scoring on average .5 to 1 SD lower in literacy and pre-math than more advantaged peers, increasing the starting point of academic trajectories in preschool holds promise for reducing achievement gaps (Duncan et al., 2007; Hindman, Skibbe, Miller, & Zimmerman, 2010; Lee & Burkam, 2002). Interactive writing in which teachers model, scaffold (i.e., assess, guide at an appropriately challenging level, and provide feedback), and engage children in a variety of early writing activities is increasingly recognized as a productive way to build early literacy capabilities, according to a recent meta-analysis of 18 preschool interventions (Hall, Simpson, Guo, & Wang, 2015).

Unfortunately, few early education classrooms are prepared for this effort. Preschoolers typically experience less than one minute of writing per day (Pelatti, Piasta, Justice, & O'Connell, 2014). Consider the cumulative effect of 2.5 hours per year in the average pre-K classroom versus 25 hours of active writing in the TOM program. Additionally, pre-K teachers who have the requisite 12-units of ECE coursework lack the specialized knowledge and skills in order to effectively scaffold writing (e.g., developmental continuum of language and literacy, assessment, individualized instruction, contemporary child development; Roskos, 2013). Consistently low levels of literacy knowledge are reported for early educators (e.g., Cunningham, Zibulsky, & Callahan, 2009). To address this deficit in early childhood programs, many experts contend that a "pre-K to grade 3" credential is needed for lead teachers. Such a credential, coupled with in-service training, would help ensure that teachers provide diverse learners with cognitively stimulating and emotionally supportive preschool experiences (Institute of Medicine and National Research Council, 2015; Yoshikawa et al., 2013). The concomitant increase in education and professionalism is expected to raise salaries, which are shamefully at near-poverty levels (Whitebook, 2014).

Consequences of low teacher preparation were evident when I collected data at a Spanish-speaking pre-K center in the same region, one with four energetic new teachers. Preliminary analyses demonstrated that only a few of the children's Play Plans across four months included letters in the message area (corresponding to scores of 4 or 5 on the EW10). Compared to a TOM data set from the previous year, these writing samples were

distinctly less mature. Although a randomized control trial is needed to establish the effect of teachers and teacher preparation on child outcomes, the high degree of teaching experience, along with years of TOM training, in the present sample may have contributed to the strong gains found.

As argued in the introduction, reliable and valid assessments of young children's writing are lacking, yet in high demand, and the present study was an explicit attempt to help fill this gap. Existing assessments and scoring systems are often unwieldy or developmentally insensitive for the pre-K age group. Although the EW10 scoring system was created specifically for TOM Play Plans, the inter-coder agreement statistics were strong, and the system could be adapted to assess other forms of early writing in pre-K. This is a promising area of future investigation and development. Furthermore, standardized writing assessments would benefit the research literature itself and help position early writing in its rightful place as a predictor of and precursor to later literacy abilities.

An important aspect of this study was the ability to examine the trajectories of children's writing development. Incorporating the analyses of children's writing trajectories in future studies would contribute valuable information to the current developmental models of writing in the field. Such analyses would serve to refine current benchmarks in early literacy at the pre-K and kindergarten levels, and help establish a valid definition of writing disability for this young age group. With these benchmarks, teachers could discern normative from non-normative growth patterns in early writing. What is considered in the typical developmental range for 3-year-olds may be cause for assessment and tailored intervention with an older student. Indeed, this pattern was observed in my study. The slower trajectory profile in this study included all ages (from 36 to 58 months of age at school entry)—and note that in this sample I excluded 20 students with an IEP. Such variability in writing skills across the age span demonstrates the value of the early identification of special needs. Utilizing writing assessments offers an opportunity for targeted support, rather than waiting until kindergarten when literacy demands increase exponentially, e.g., "…write sentences to compose opinion pieces, information/explanatory texts, and narratives" in the Common Core State Standards (California Department of Education, 2013). On the other hand, the accelerated progress in early writing evident in this sample affirms my prediction that with scaffolded support, young children can progress in their writing development prior to kindergarten. This finding underscores and highlights the importance of incorporating a systematic, developmentally sensitive, and engaging curriculum in the early years in pre-K classrooms, such as the TOM scaffolded writing program, that includes intensive, on-going professional development.

Limitations

This study has several key limitations. Although the use of Play Plans provided an unprecedented opportunity as a repeated measure for capturing gains in early writing, there were notable issues with their utilization. First, it could be argued that the standard prompt for Play Plans (i.e., the stem: *I am going to*…) constrains children's opportunity for expressive writing. On the other hand, daily practice with a familiar sentence prompt may provide a consistent routine to stimulate writing growth.

Second, the degree of teacher scaffolding was not uniformly clear, possibly affecting scoring. For example, at times the teacher's writing or assistance was evident by use of a different color pen (and thus not counted in the scoring of the child's writing), yet at other times it was difficult to ascertain whether "lines for words" (EW10 score of 3) were drawn with teacher's help. No doubt this uncertainly compromised fully accurate scoring and subsequent trajectory analyses. Nonetheless, given that TOM teacher training stresses scaffolding at *only one level above* a child's current independent skill level, consistent with the Zone of Proximal Development, the EW10 scores may not be unreasonably inflated.

Third, the coding of a completed Play Plan provided an off-line and therefore limited measure of children's emergent writing. More insight could undoubtedly be gained from recording the process of writing, documenting in-the-moment speech, action, teacher and peer support (such as provided by the Educreations app, 2012). However, an average of 16 writing samples from six months of pre-K offers a unique contribution, extending longitudinal evidence for trajectories of early writing (e.g., Juel, 1988; Lieberman, 1985).

Fourth, this study of early writing samples did not include other early literacy assessments (e.g., phonological awareness; letter identification). Additional tests would provide a richer contextualization of children' early writing trajectories.

A final limitation was the small sample size of 62, which precluded a formal cluster analysis to discover trajectory groups—and which was limited to English-speaking children. Generalization via larger and more diverse samples, along with demographic information, is needed.

Future Directions

Future directions include a planned follow-up study of kindergarten and elementary school literacy scores for this sample, investigating the predicative validity of the EW10 scores and their trajectories. Indeed, although beyond the scope of the present dissertation, I plan on examining the relation between kindergarten (and later) literacy skills from both (a) the initial and final levels of name writing in pre-K and (b) the trajectory scores of the children, when such outcome data become available. There is great potential for including a larger, more representative data sample in the future, as the TOM curriculum is now used in 18 U.S. states, as well as in Canada and Chile. Studies of writing development in Spanish with dual language learners are essential. Children's growth in oral language abilities, perhaps using Mean Length of Utterance (MLU) to analyze TOM Play Plan messages, is also relevant. In terms of the EW10 measure, next steps include a psychometric evaluation study, possibly using Item Response Theory, in order to revise and refine this scoring system.

Although time constraints prohibited examining all aspects of the TOM Play Plans, additional next steps include investigating young children's drawing. Devising experiments to test the constructivist theory that "drawing precedes writing" (Bodrova & Leong, 2007) will be an exciting challenge. Future presentations will include the video animations of several children's Play Plans depicting unfolding growth in both drawing and writing. Research into young children's drawing development has been relatively neglected since the advent of standardized testing in the 1990's, yet inquiry into the association of early graphic representational abilities with later literacy and general cognitive development is reviving, including investigations of the role of genetic contributions (see Arden,

Trzaskowski, Garfield, & Plomin, 2014). Among a multitude of questions to pose in this area, several important ones include the following: What are the processes of building conceptual representations, such as symbols, that affect later comprehension and composition abilities? How can Science, Technology, Engineering, the Arts, and Math (STEAM), as well as digital literacies, be used in the earliest grades to build essential background knowledge (Pearson, Moje, & Greenleaf, 2010)? The continued integration of biological, neuroscience, and social science research has the potential to yield findings that improve and innovate learning during the foundational pre-K years (Blair & Raver, 2014; James et al., 2015; Shonkoff & Phillips, 2000).

Conclusion

In sum, the repeated measure design of this study provided a valuable window into early writing development over a six-month period in pre-K. From my initial view of daily Play Plans fanning across one teacher's door to the present repeated-measures examination that comprises this dissertation, I agree with Dr. Bodrova (Tools of the Mind co-creator) that these data represent a "gold mine." Nearly 2,000 pages of TOM Play Plans were available for this study and the creation of the EW10, documenting children's progress in forming lines into first letters, words, and messages. Indeed, writing, for all ages, involves transforming and organizing thoughts into transcribed text. This study of 62 children's trajectories demonstrates the early origins of this complex skill set that is uniquely human.

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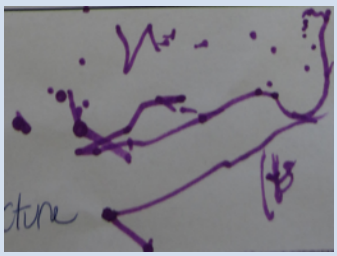
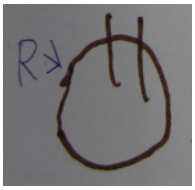
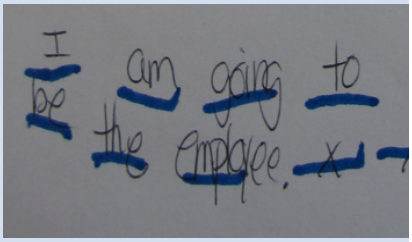
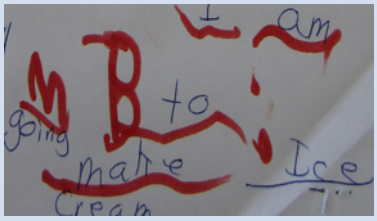
Table 1

EW10 Scoring System (with *Play Plan* message: "I am going to…")

Score	Title	Criteria	Example
0	Not attempted		
1	Scribble marks	-Random (or mostly random)	
2	Writing-like shapes or lines	-More intentional -Constrained units or wavy lines	 
3	Lines represent words in speech	-Clear, horizontal lines -1, 2, or 3 rows - "> stable"	
4	1 or 2 letters (recognizable) *List:*	-Intentional -Independently identifiable -Mostly accurate form	

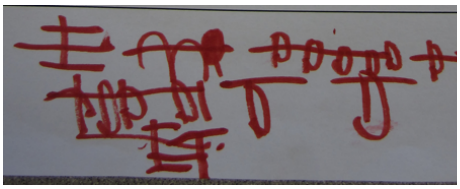
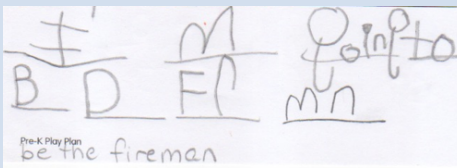
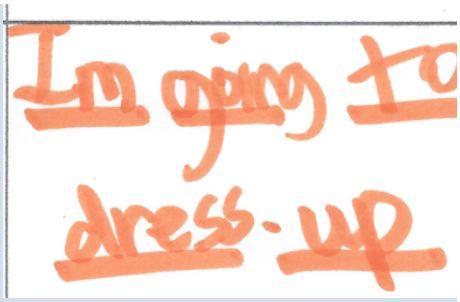
5	3 or > letters *List:*	-Same criteria as above -Little evidence of letter-sound correspondence	
6	Beginning Letter-Sound (<25%)	-Letter-sound correspondence in at least 2 words after prompt (e.g., …build a course)	
7	Medium Letter-Sound (25-49%)	-Several sounds (e.g., initial & final) in at least 2 words after prompt	
8	Estimated Spelling (>50%)	-Letter-sound in several words (including middle sounds) -You can "read" the message	
9	> Conventional Spelling	-All words spelled *almost* correctly (strong Alphabetic Principle) - Use of some orthographic patterns/rules	
10	Conventional Spelling	-Correct spelling -Use of punctuation	(sample to be added)

Table 2

HLM Coefficients for Effects of Week and Predictors

EWo0	Coef.	Std. Err.	z	P> [z]
Week^1	.8414157	.0937538	8.97	0.000
Week^2	-.0929688	.0145675	-6.38	0.000
Week^3	.0047546	.0008575	5.54	0.000
Week^4	-.0000857	.0000169	-5.06	0.000
Gender	-.2651297	.1660911	-1.60	0.110
Age (months)	.0129476	.0225044	0.58	0.565
TOM years	.3125966	.1768066	1.77	0.077
Name (entry)	.3530035	.0776164	4.55	0.000
_cons	-1.516104	.9274208	-1.63	0.102

Figure 1

E10 Trajectory Scores, by Week, for All Participants

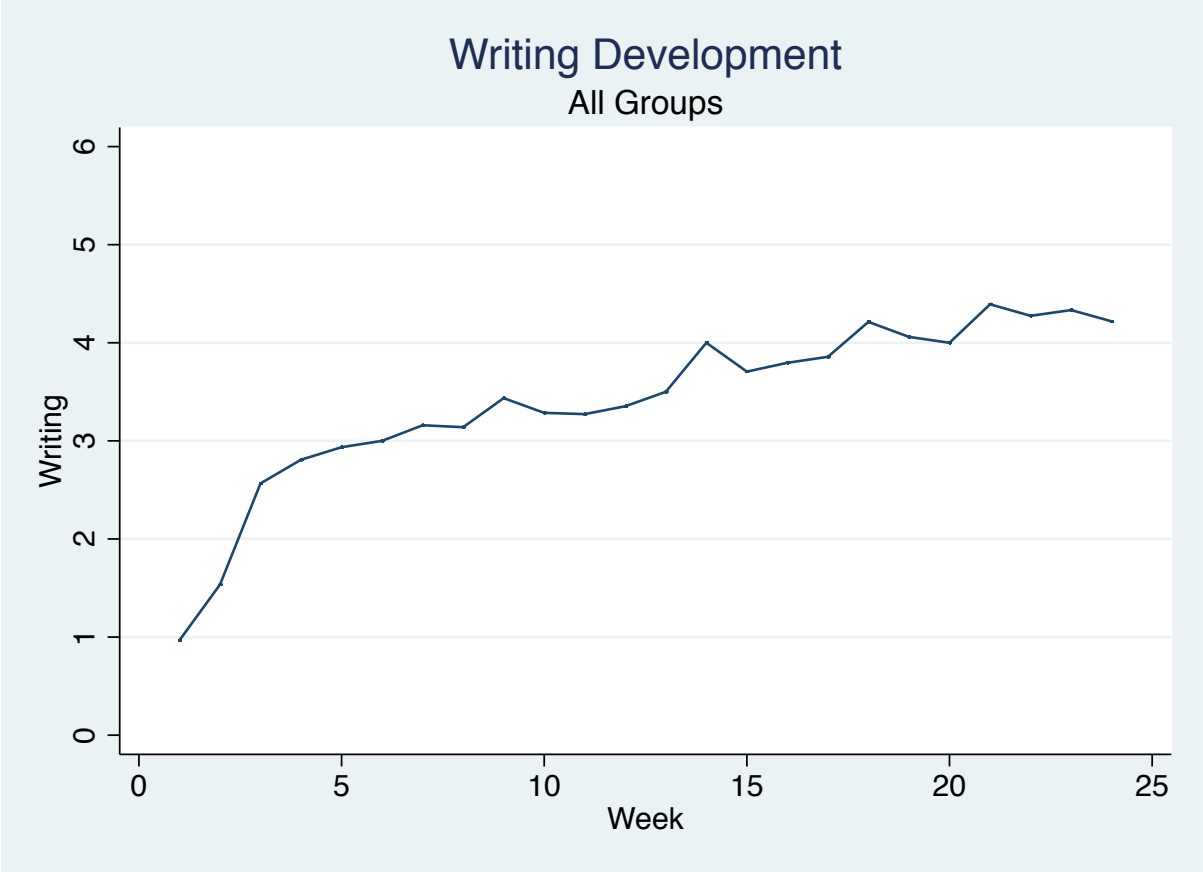
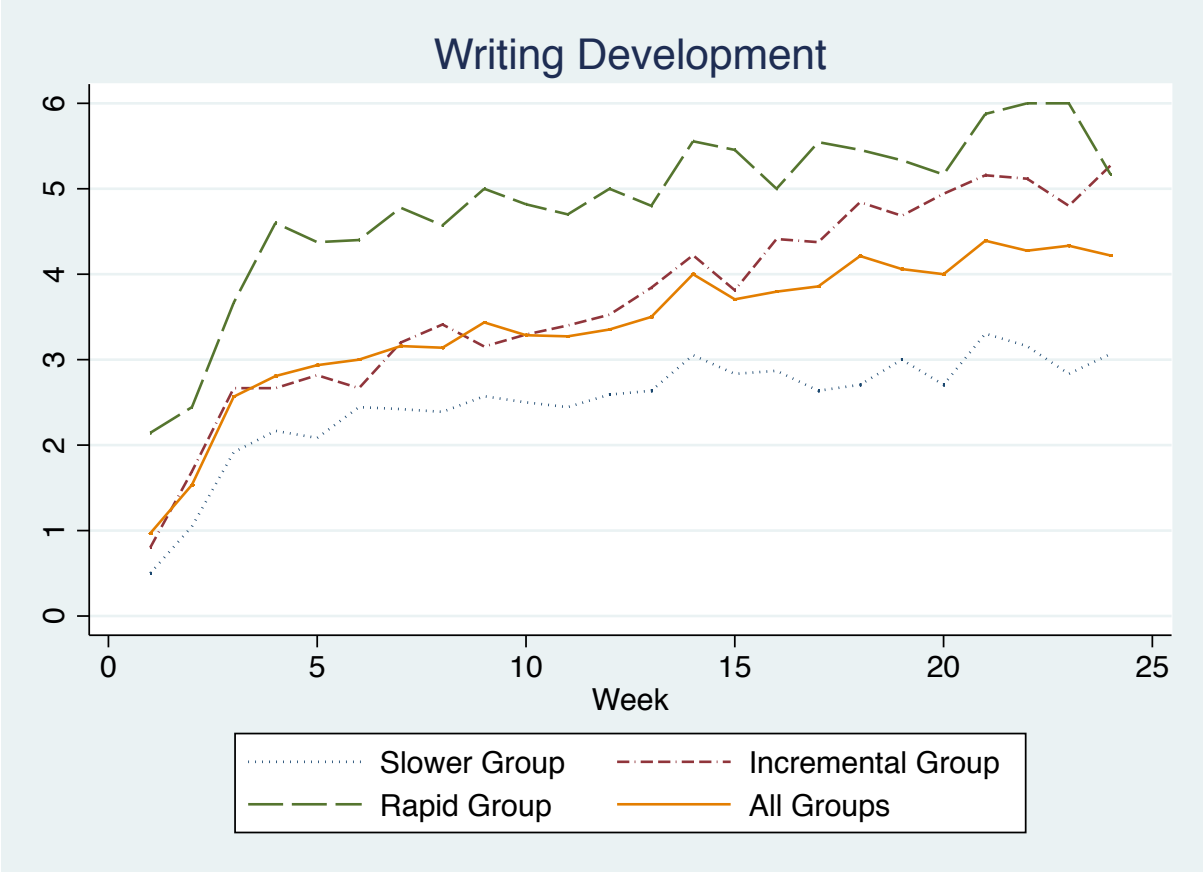


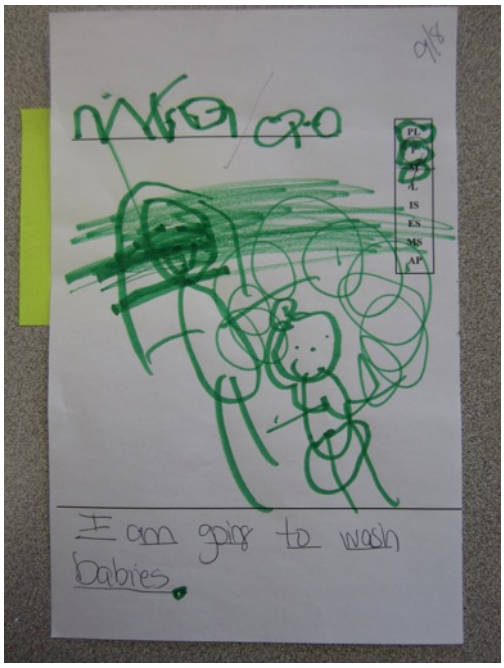
Figure 2

EW10 Trajectory Scores, by Week, for Three Defined Trajectory Groups



Appendix A

Play Plan Examples (September to March): *Myra*, age 4



1.

2.

3.

4.

Appendix B

EW10 Scores by Week for Each Participant