WHO'S COUNTING? NUMERACY AND LITERACY PRACTICES OF EARLY LEARNING AND CHILD CARE PRACTITIONERS

Jo-Anne LeFevre, Lisa Fast, and Carla Sowinski,

Carleton University

Helena Osana,

Concordia University

Sheri-Lynn Skwarchuk

University of Winnipeg

Natalia Manay Quian

Brock University

Date Submitted: 2009 March 12

TABLE OF CONTENTS

Executive Summary

Competence in mathematics is necessary for individuals to successfully compete in an increasingly scientific and technological world. On international assessments, Canadian children perform better than American children, but nevertheless do not do as well as Asian and European children. Furthermore, because children's competency in mathematics before school entry is very predictive of their later performance, early experiences are critical in getting children off to a good start. Our goal in this study was to gather information about the early numeracy and literacy knowledge, practices, and beliefs of early learning and child care (ELCC) practitioners. This initiative was the first Canadian large scale attempt to gather information about ELCC early numeracy practices. A web survey of Canadian Child Care Federation members and recruiting at two major childcare conferences recruited 768 respondents. The majority of respondents were from Manitoba, Ontario and British Columbia. The respondents were well educated–12% reported university degrees, and almost 60% reported college diplomas. One third worked in administrative and instructor roles, another third worked directly with children in childcare centres and the final third worked directly with children in their home (18%), or in nursery schools, or other programs.

Perceived Knowledge of Numeracy and Literacy and Professional Development

We hypothesized that ELCC practitioners may have little knowledge of what constitutes 'early numeracy' or of how to deliver numeracy content using developmentally appropriate practices. Consistent with this prediction, respondents indicated that they felt significantly more knowledgeable about early literacy than about numeracy. They reported attending early numeracy professional development less frequently than other learning activities and were less aware of the availability of early numeracy learning opportunities in comparison to professional development concerning literacy, social skills, or health and safety.

Knowledge about Children's Capabilities. As hypothesized, ELCC practitioners varied in their knowledge of children's capabilities. Based on their responses about the ages at which children become capable of early numeracy and literacy activities (e.g., count to 10, read a few words), the respondents clustered in two groups: one group indicated that children were capable of these skills at a younger age (on average, about a year earlier) than the other group. This "Capable Younger" group gave responses that were consistent with the developmental literature

on when typical children master these skills. This group was also more likely to have worked with children for 10 or more years as compared to the "Capable Older" group. Thus, respondents varied in how knowledgeable they were about children's capabilities, and their knowledge was related to their experience in working with children.

Practices. Respondents reported how frequently they participated in a set of literacy, numeracy and social-emotional activities: 428 respondents worked with preschoolers (i.e., children aged 3 and 4 years) and 156 respondents worked with toddlers (i.e., aged 1 and 2 years). In general, across both age groups, ELCC practitioners reported pre-reading and quantity activities less frequently than language and counting activities, suggesting that although ELCC practitioners engage in many *basic* literacy and numeracy activities, they are doing fewer *advanced* activities within these domains.

Beliefs. We hypothesized that the ELCC respondents would believe that early numeracy practices are less important than similar early literacy skills, and less important than social and emotional skills. Indeed, the majority of respondents agreed or strongly agreed that social and emotional development is the primary goal of early childhood education. However, the majority of respondents *also* believed that it is their job to teach children about letters, and they believed that numeracy and literacy skills should be assessed regularly. Thus, we did not find that ELCC practitioners rejected a role for early literacy and numeracy experiences in the child-care setting; instead, they varied in whether these activities should be initiated by the children or by adults (as described below).

A cluster analysis of the beliefs revealed that respondents varied in the extent to which they believed that children (vs. adults) should initiate early numeracy and literacy activities. We identified three groups along this dimension, which we labeled *Moderate* (40% of the sample), *Child-Initiated* (39%) and *Adult-Guided* (21%). The defining beliefs for these clusters and associated knowledge, confidence and practices are outlined in Table 1. The Moderate and Child-Initiated groups tended to underestimate children's capabilities. They were more likely than the Adult-Guided group to report being avoidant of mathematics and they reported that children are not capable of early arithmetic until age 5. Accordingly, they were less likely to report frequent use of numeracy activities beyond basic counting, presumably because they believe such activities would not be developmentally appropriate for the children in their care. This perspective was clearly captured in a survey respondent's comment about numeracy

practices: "If it is not DAP (developmentally appropriate practices), I won't do it. It's the parents and politics that are curriculum oriented."

Recommendations

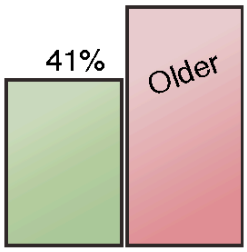
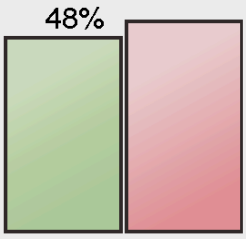
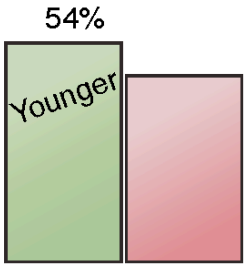
The results of this survey suggest some first steps for improving and supporting early numeracy education for ELCC practitioners. Given that children learn best in a developmentally appropriate environment, providing information about the early capabilities of children may convince ELCC practitioners that early mathematics is developmentally appropriate. Accordingly, the survey results are being used in partnership with CCCF and CLLRNet to develop an evidence-based Resource Sheet that outlines children's early numeracy capabilities.

In addition to providing training on children's capabilities, ELCC practitioners need information about fun and effective early numeracy activities that will increase children's participation, encourage children to initiate these activities, and minimize opting out. Child Initiation is a key belief of over one-third of the respondents. These practitioners indicated that they no longer use worksheets or flashcards, because they do not see these materials as developmentally appropriate. However, they do not appear to know of activities that will help children to experience age-appropriate numeracy activities beyond the counting games that they already perform on a daily basis. Many respondents suggested that they want to learn about other early numeracy activities, and even that the activities assessed in the survey had given them ideas about what they could do. Because the less-experienced practitioners are least knowledgeable about appropriate early numeracy activities, materials directed at college-level preservice programs would have the most impact. However, a greater availability of professional development activities targeting practitioners' knowledge and practices, possibly in combination with further early literacy activities, would also address the gaps identified by survey respondents.

Summary

In summary, this extensive survey of Canadian early learning and childcare practitioners highlights two key opportunities to improve the state of early numeracy education in Canada. ELCC practitioners are aware that they lack knowledge about early numeracy, and that they have few opportunities to address that need. Thus, targeting preservice and in-service training about children's capabilities will open the door to heightened awareness and attention towards children's numeracy development. The second opportunity lies with the group of practitioners

eager to acquire more knowledge about developmentally appropriate activities covering the range of early numeracy – from arithmetic to measurement. Resources to address both of these opportunities are in development in partnership with the Canadian Child Care Federation and the Canadian Language and Literacy Research Network.

Early Learning Survey Summary: Characteristics of clusters of survey participants by beliefs, knowledge and practices.			
	Child-Initiated Cluster	**Moderate Cluster**	**Adult-Guided Cluster**
Size of Cluster	n = 305	n = 297	n = 164
Shared Belief	**Social & Emotional growth is the primary goal.**		
Defining Beliefs	All activities should be child–initiated.	All activities should not be child-initiated.	All activities should not be child-initiated.
	Children should be allowed to opt out of numeracy & literacy activities	Children should not be allowed to opt out.	Children should not be allowed to opt out.
	Preparation for school is not the most important goal.	Preparation for school is not the most important goal.	Preparation for school is the most important goal.
Knowledge of children's early numeracy capabilities			
	Tend to think kids are not capable until older		Tend to think kids are capable at younger ages
Knowledge of Early Numeracy	Most feel knowledgeable, but many do not	Most feel knowledgeable, but some do not	Almost all feel they are sufficiently knowledgeable
Math Confidence	Tend to avoid math	Tend to avoid math	Confident about their math skills
Importance ratings for Simple Arithmetic	Not really important before Grade 1	Not really important before Grade 1	Important before Grade 1, but not as important as reading
Early numeracy activities with children	Play some counting games	Play some counting games	Frequent counting games and some quantities & early arithmetic
Recommendations	**Target resources on children's capabilities first**	**Provide resources on children's capabilities and activities**	**Provide resources on full range of early numeracy**

Acknowledgements

The Canadian Council on Learning (CCL) and the Canadian Language and Literacy Research Network (CLLRNET) provided funding for this research. CLLRNET provided the funding for the summer studentship awarded to Natalia Manay Quian. The research was sponsored and supported throughout by the Canadian Child Care Federation (CCCF).

We would like to thank Anne Maxwell of the CCCF who collaborated with us throughout the research process. Claire McLaughlin assisted with preparation of the Executive Summary and the version circulated to the membership of the CCCF through *Interaction*. Elin Ibrahim and several other anonymous experts provided feedback on an early version of the survey. Diana Royea contributed to the analysis of children's capabilities. Research assistants Lori Mergulhao and Jessica Robinson assisted with data collection in Manitoba. Steve Hume provided invaluable assistance with the figures and other computer 'stuff'.

Most importantly, we thank the respondents who contributed their valuable time and expertise to answering the survey questions. We appreciate the care and patience with which the respondents considered the (many) queries in the survey. We hope that the findings are of interest to the ELCC community.

Part I: Why is success in mathematics important for children in Canada?

Competence in mathematics is necessary for individuals to successfully compete in an increasingly scientific and technological world. Unfortunately, North American children consistently underperform compared to their peers from Asia and Europe. Even within North American society, children from disadvantaged circumstances perform less well on mathematical tasks than those who come from middle- or upper-middle class homes (Arnold & Doctoroff, 2003; Clements, 2004a; Ginsburg, Lee, & Boyd, 2008; Jordan, Kaplan, Locuniak & Ramineni, 2007). Furthermore, because competency in early mathematics is predictive of later performance (Aunola, Leskinen, Lerkkanen & Nurmi, 2004; Jordan et al., 2007), it is important for children to start off 'on the right foot'. Thus, early numeracy experiences at home, daycare, preschool, and kindergarten are relevant for understanding children's mathematical development. In the current report, we review existing literature on children's early numeracy experiences and then present the results of a survey of over 700 early childhood educators. Our goal was to determine the knowledge, practices, and beliefs of these educators about numeracy activities in daycares and preschool settings.

The need to provide equity in education, and to effectively compete in the global economy in years to come, has turned our focus towards providing children with authentic mathematical experiences earlier in school and even before school starts. Although children have always had mathematical experiences before school, beliefs about the developmental appropriateness of various pedagogical activities have shifted considerably over time (Ginsburg et al., 2008). Furthermore, there is a growing body of research suggesting that the capabilities of young children have been underestimated, and that they should be taught more mathematical skills prior to entering Grade 1 than they have been taught in the past (Ginsburg et al., 2008). Thus,

currently and in the future, the expectations for children's learning about mathematics and related content before they begin formal schooling are likely to increase among policy makers, educators, and parents. A better understanding therefore of the current state of affairs in regards to the practices and views of individuals responsible for children's early experiences is thus important for guiding the development (or reform) of existing programs.

For early childhood mathematical education to be successful, early learning and childcare (ELCC) [1] practitioners need to be knowledgeable about the developmental trajectories of children in relation to mathematics. They also need to know *what* knowledge children need and *how* to teach these concepts to young children. Furthermore, for ELCC practitioners to be effective at providing early numeracy experiences to children, they need to value mathematics as a subject, feel confident in their abilities to teach math, and believe that early numeracy experiences are developmentally appropriate. Thus, this research project was designed to inform us about the knowledge, beliefs, and practices concerning early numeracy of ELCC practitioners in Canada. We also asked about early literacy practices, as the importance of the relations between early literacy experiences and reading acquisition is well established (Evans & Shaw, 2008; Green, Peterson & Lewis, 2006; Lonigan & Whitehurst, 1998; Sénéchal & LeFevre, 2002; Snow, Burns & Griffin, 1998). Children who are read to have better knowledge of word meanings and are more likely to become readers (Sénéchal, LeFevre, Hudson, & Lawson, 1996; Sénéchal, 2006) and children who have early experiences with letters and the sounds that make up words are better prepared to learn to read (Evans & Shaw, 2008; Sénéchal & LeFevre, 2002).

---

[1] Early learning child care practitioners is the term used to include early childhood educators, preschool teachers, people employed in daycares, Montessori teachers, home child care providers, and anyone else who may provide non-parental care for children on a regular basis. This term was selected because it describes a broad group of individuals who are responsible for children before they enter school.

We use the term 'numeracy' to include both conventional knowledge of the symbolic number system, such as the Arabic symbols and spoken words for each number, as well as the knowledge of numerosity or quantity that is available when people view and reason about a group of objects. More generally, we use 'numeracy' as an analogue to literacy. A person who is literate can read and use written text for a variety of everyday activities. Similarly, an individual who is numerate can use numbers in everyday life: for shopping, banking, estimating, understanding economic issues, determining medications, and so on. Many jobs that are not explicitly mathematical include considerable use of numeracy, such as food preparation, construction, graphic design, or nursing. Some researchers have used the term 'quantitative literacy' to encompass the concept of using numerical information in meaningful tasks (e.g., Steen, 1997), but we prefer, especially with children, to make a clear distinction between literacy that involves words and literacy that involves numbers.

The information about numeracy and literacy activities that we obtained from the survey respondents was largely descriptive, but it provides a first glimpse of how numeracy activities are viewed and implemented by ELCC practitioners in Canada. The information about literacy activities provides an important context. For at least 20 years, the role of early literacy activities in fostering reading acquisition has been a prominent topic in early childhood education (reviewed by Evans & Shaw, 2008) and thus allows us to discuss the relative focus on numeracy versus literacy. The information provided by the ELCC practitioners will also allow us to share their examples of successful strategies and practices with others in this community.

Predictors of Academic Outcomes

Literacy, Numeracy, and Social-Emotional Factors in Early Childhood Education

In order to implement effective early childhood educational programs, it is essential for educators to understand which skills are linked to children's academic achievement and if, or when, to integrate specific skills into early childhood programs to better promote academic skills before children enter elementary school. Duncan and colleagues (2007) examined six longitudinal data sets to determine the predictors of later academic achievement. Their analyses indicated that school-entry reading, language, and math skills predicted later academic achievement, whereas attention was a moderate predictor, and socio-emotional factors, as measured by behaviour problems and social skills, did not significantly predict academic outcomes. Interestingly, although both were strong predictors, early math abilities were found to be more predictive of later academic achievement (in general) than were early reading skills. In fact, early math skills were as predictive of later *reading* achievement as were early reading skills. Early numeracy concepts such as knowledge of numbers and ordinality were the strongest predictors of later learning, followed by language and reading skills such as vocabulary, knowing letters, and knowing beginning and ending word sounds. Although more research is needed to determine the causal relations between early numeracy skills and academic outcomes, these results suggest that learning early numeracy concepts is correlated with later success.

Duncan et al.'s (2007) finding that socio-emotional factors did not predict academic outcomes is interesting because ELCC practitioners and parents tend to agree that socio-emotional development is one of the most important goals of early childhood education. Clearly, children with social skills deficits or emotional difficulties will have trouble adjusting to school. Socio-emotional development was not the focus of the current research project, however. We

asked about some factors relevant to socio-emotional development, to make the survey comprehensive, and to allow the comparison of beliefs and practices related to socio-emotional development with beliefs and practices related to numeracy and literacy development (see Missall & Hojnoski, 2008 for a review of social competence and its importance in early childhood).

How do Canadian mathematical skills compare to those of people in other countries?

There is a substantial literature on the relatively poor performance of American children on mathematical tasks to those of children in Asian countries. In seminal work, Stevenson, Lee and Stigler (1986) noted that measurable differences in the mathematical achievement of Americans compared to other countries are present as early as kindergarten (see also Siegler & Mu, 2008) and persist throughout elementary school. Stevenson et al. conducted a cross-sectional study comparing Japanese, American, and Taiwanese children in Kindergarten, Grade 1, and Grade 5. Results on tests of mathematical achievement revealed that the Japanese children performed significantly better than the American children at Kindergarten, Grade 1, and Grade 5. The Taiwanese children also significantly outperformed the American children at the Grade 1 and Grade 5 levels (see also Ginsburg, Bempechat, & Chung, 1992; Stevenson, Lee, Chen, & Lummis, 1990). The relatively poor performance of American children on international tests is of considerable concern in that country and has fueled changes in mathematical education in the US, as described by the National Council of Teachers of Mathematics in their Principles and Standards for School Mathematics (2000). A recent advisory council produced a report detailing further ways that mathematics education in the US should be improved (National Mathematics Advisory Panel, 2008).

In contrast to Americans, Canadian children tend to perform relatively well on international assessment tests (e.g., TIMSS, PISA). However, such measures tell only a part of the story. In 20 years of research on the arithmetical abilities of Canadian adults, we have observed a significant decline in performance (LeFevre et al., 2006) and increasingly negative views of mathematics. Many adults are anxious and avoidant of mathematics (Ashcraft & Ridley, 2005), even though they often use mathematics on a daily basis (LeFevre, Kulak, & Heymans, 1992). Even university students appear to find relatively simple arithmetical tasks difficult and unrewarding (Osana, Rayner, Desrosiers, & Levesque, 2007; Rayner, Pitsolantis, & Osana, 2007). Thus, there are a variety of indices that suggest that the performance of Canadian students in mathematics is not optimal.

In a world that is increasingly technological and scientific, fluency in mathematics is necessary if Canadians expect to succeed in the global economy (Clements, 2004a). Ginsburg et al. (2008) argue that the present mathematical situation is harmful to children and to the US economy as a whole, and suggest that improvement or serious reform is necessary. One way to change things for the better is for early childhood mathematics education to become more effective, as this education provides the basis for future mathematical and scholastic success, and also presumably lays the groundwork for adults' attitudes and beliefs about the importance, accessibility, and relevance of mathematics to everyday life.

Factors Affecting Mathematical Achievement

Recent longitudinal studies have shown that children's early numeracy skills (assessed before or during in Kindergarten) are very predictive of mathematics achievement in Grade 1 (Jordan et al., 2007; Passolunghi et al., 2007) and beyond (Aunola et al., 2004; Duncan et al., 2007). Furthermore, the development of math performance seems to be cumulative across time.

For example, Aunola et al. (2004) found that children with high levels of numeracy skill in kindergarten progressed rapidly during the period between preschool and Grade 2, whereas children with lower levels of numeracy skill in kindergarten improved less over this time period. Thus, it seems that adequately preparing young children for school mathematics may benefit them well into the future.

Research conducted in the U.S. suggests that both early and later differences in mathematics achievement are related to socio-economic status (SES, i.e., Arnold & Doctoroff, 2003; Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Clements, 2004a, Ginsburg et al., 2008; Jordan et al., 2007). Children from economically disadvantaged backgrounds are less prepared for school than their more affluent peers (Clements, 2004a; Jordan et al., 2007. Low SES is often confounded with ethnicity in American samples (Campbell et al., 2001; Seo & Ginsburg, 2004). Children should experience equity within the early education system such that all individuals are given the opportunity to learn the skills necessary to succeed academically. Fortunately, there is substantial evidence suggesting that interventions involving low SES children result in improved academic success, at least over the short term (Campbell et al., 2001; Ginsburg et al., 2008), and sometimes in the long term (Ludwig & Phillips, 2007).

Campbell et al. (2001) conducted a longitudinal intervention in which children were followed from 3 to 21 years of age. Groups of low-SES children were randomly assigned to an intervention or control condition. Children in the intervention group were provided with high quality childcare, which included instruction designed to promote cognitive development in a variety of areas. The children in the control group received a range of childcare, from parental care to out-of-home childcare of various qualities. Measures of cognitive development and academic achievement were taken across time. The cognitive growth curves of the intervention

and control groups remained parallel between the ages of 3 and 21. Children in the intervention group scored higher on intelligence tests across the study, although differences were larger during, and immediately following, the intervention in early childhood. Children in the intervention group also performed better than those in the control group on achievement measures of reading and mathematics. Although both groups demonstrated a decline in cognitive growth relative to national norms, the intervention group still performed better than the control at age 21, suggesting that the early childhood education intervention produced long term cognitive advantages.

Thus, better preparation of future generations for mathematics education for children of all backgrounds and ethnicities may start with improvements in early childhood mathematics education. Furthermore, beginning math instruction in the early years may be especially advantageous because young children of both low and middle SES have positive beliefs about their ability to do well in school (Ginsburg et al., 2008; Stipek & Ryan 1997). These factors support a greater understanding of how early numeracy experiences are integrated into early learning.

Developmentally Appropriate Practices in Early Childhood Education

The National Association for the Education of Young Children (NAEYC) suggests that teachers should engage in "developmentally appropriate practices" (i.e., DAP), which is currently the dominant philosophical model in early childhood education (Kowalski, Pretti-Frontczak, & Johnson, 2001; Stipek & Byler, 1997; Wang, Elicker, McMullen & Mao, 2008). Implementation of a DAP perspective involves ensuring that educational practices are adapted to a child's developmental level (Kowalski, et al., 2001; Stipek & Byler, 1997). ELCC practitioners endorsing the DAP philosophy would create a child-centered environment in which

children learn through self-initiated activities, concrete experiences, exploration, and discovery learning. These practitioners would not endorse activities that involve structured teaching of basic skills using drills, lectures, worksheets, and other abstract activities because they are not child directed and place too much emphasis on formal academic instruction, repetition, and practice (Charlesworth, Hart, Burts, Thomasson, Mosley, & Fleege, 1993; Ginsburg, et al., 2008; McMullen, Benson, et al., 2006; Stipek & Byler, 1997). The DAP philosophy is based on the theory, mostly developed by Piaget, that children learn by solving problems through concrete experiences and manipulating objects (Stipek & Byler, 1997) – that is, through play in rich but natural environments. According to this perspective, by providing deliberate and planned instruction in highly structured environments, adults can interfere with the natural learning process (Ginsburg, et al., 2008; Stipek & Byler, 1997).

In this report, we reject the view that early numeracy and literacy activities are developmentally inappropriate. Instead, we allow for the possibility that children can acquire these skills within an environment that implements DAP principles. Thus, a practitioner could hold a very strong DAP philosophical stance, but still endorse practices that facilitate the acquisition of basic literacy and numeracy skills in preschool children. However, when we surveyed existing literature on the practices and beliefs of ELCC practitioners, it appeared that either they or the researchers had not separated the DAP and basic skills dimensions (e.g., Stipek & Byler, 1997). We hypothesized that ELCC practitioners would most likely hold a strong DAP perspective, but that they may also be providing considerable mathematical content to children, which would include play and hands-on activities, in ways that are consistent with their perceptions of the developmental capabilities of the children. Thus, to the extent that ELCC

practitioners identify themselves as providing early numeracy experiences, it is likely they would occur in play-based contexts.

The emergent literacy view of literacy acquisition is, in large part, consistent with both DAP and basic skills orientations. Early literacy experiences can be provided through a DAP approach with an emphasis on child-initiated activities, reading books, or using manipulatives such as magnetic letters to form words. Although literacy can also be taught using a more formal, teacher-directed approach through the use of worksheets, tracing letters, and memorizing the alphabet, these activities are not appropriate for preschoolers and thus would not form part of the emergent literacy curriculum. Similarly, numeracy practices can be consistent with DAP strategies, such as counting with concrete objects and manipulatives, reading books that involve numbers and other math concepts, and child-initiated activities, because children show a spontaneous interest in math concepts without any formal instruction (Ginsburg et al., 2008; Seo & Ginsburg, 2004). Thus, early numeracy experiences should not be equated with schoolwork; as with early literacy experiences, appropriate numeracy activities can be incorporated into children's play. Thus, in designing survey questions, we situated questions about early numeracy and literacy practices within a framework that *was* consistent with a DAP perspective.

Children's Cognitive Capabilities for Early Numeracy: When are they Ready to Learn?

Ginsburg et al. (2008) discussed the substantial body of research showing that children develop various mathematical concepts through everyday experiences during the period between birth and age 5 (see also Baroody, Lai & Mix, 2006; Bisanz, Sherman, Rasmussen, & Ho, 2005; Ginsburg, Cannon, Eisenband, & Pappas, 2006). Children come to know "informal ideas of more and less, taking away, shape, size, location, pattern and position" (Ginsburg et al., 2008, p. 3).

The mathematical knowledge gained through everyday activities seems to occur as a natural component of cognitive development, often without any adult instruction (Ginsburg et al., 2008).

Children's exploration of their environment results in spontaneous mathematical activities. For example, children often count during play periods without any prompting (Ginsburg et al., 2008; Saxe, Guberman & Gearhart, 1987). Seo and Ginsburg (2004) observed 4- and 5-year-olds of various SES backgrounds to see how often they engaged in spontaneous mathematics activities. During the 15-minute observation period, 79 of 90 children (88%) participated in at least one mathematical activity. Of these children, 7 of the 15 minutes on average were spent on mathematical activity, suggesting that children spend a considerable amount of their free play time engaged in mathematical activities. There were no significant income-level or gender related differences in time spent on these activities (Ginsburg et al., 2008). Thus, children appear to engage spontaneously in certain early numeracy activities.

Of course, there are some limitations to the cognitive capabilities of young children. They think in relatively concrete terms, and tend to perform better on math tasks with concrete objects or manipulatives than they do on mental tasks (Ginsburg et al., 2008; Young-Loveridge, 1989). Regardless, young children understand that adding objects always results in *more*, and taking away objects always results in *less* (Ginsburg et al., 2008; Seo & Ginsburg, 2004). Recent theoretical treatments of the origins of mathematical knowledge stress that human infants, rats, and pigeons have an awareness of quantity (Brannon, 2005; Butterworth, 2005). Presumably this evolutionary capacity to appreciate quantity forms the basis of children's acquisition of the symbolic language that humans have developed so that we can deal with exact quantities and large numbers (Bisanz et al., 2005; Geary, 1994).

Accordingly, Ginsburg et al. (2008) suggested that mathematics education in early childhood largely consists of teaching children the language of mathematics. Children must first learn the words for the first ten numbers, which are essential arbitrary labels that must be memorized. Later, they learn rules for generating larger numbers. Young children also learn the names of shapes (e.g. triangle, rectangle), and words to express quantity (e.g. more, less, bigger). Ginsburg et al. (2008) note that these words are so ubiquitous that many ELCC practitioners may not conceptualize them as *math* words, and may categorize them as part of cognitive development in a more general sense. Children also develop an awareness of their own thinking processes and become able to express their ideas in words; this is known as metacognitive knowledge. Mathematical understanding and ability to solve problems are thought to improve once metacognitive knowledge is present.

According to Ginsburg et al., learning the printed symbols (e.g., digits and signs used to express operations) is considered to be the most difficult step in mathematical acquisition. Although young children find it easy to find the solution given concrete objects (e.g., they have 2 apples, and you give them 3 more, they can tell you they have 5), it takes some time before they can perform this same operation in a written format, as they have to learn the symbols, the rules to combine them, and the mathematical procedures that operate on those symbols (2 + 3 = 5). The information children learn about the symbolic frames used for mathematics we refer to as 'number system knowledge'. Learning the basics of the number system is the major task of Grade 1 and children who have rudimentary knowledge from preschool and kindergarten are better prepared than their less-informed peers (LeFevre et al., 2008). Thus, understanding how to enhance learning of number system knowledge in an appropriate way for young children is an important goal of early childhood education.

Children of lower SES tend to perform less well than their peers of higher SES on measures of math achievement and fluency (Arnold & Doctoroff, 2003; Campbell et al., 2001; Clements, 2004a, Ginsburg et al., 2008; Jordan et al., 2007). Nevertheless, research indicates that low SES children demonstrate a sufficient amount of early numeracy knowledge on which mathematics education can build. For example, when young children are given mathematical tasks that do not depend on language or knowledge of the conventional number system, low-SES children perform as well as middle-class children (Jordan, Huttenlocher & Levine, 1992). Similarly, Aunio et al. (2006) found that Chinese children outperformed Finnish children on number tasks that required knowledge of the number system, whereas tasks tapping nonverbal quantity understandings were not different across cultures. These results indicate that the difficulties experienced by children of low SES can be addressed through better preparation before school begins.

The research showing that young children (a) spontaneously participate in mathematical activities, and (b) that they acquire various mathematical concepts with little or no instruction from adults suggests that early numeracy activities are developmentally appropriate (Ginsburg et al., 2008). Hence, the focus turns to early learning and childcare practitioners—are they ready, willing, and able to provide appropriate and useful early numeracy experiences?

Summary

In summary, the existing research with parents and teachers of school-aged children suggests that it is crucial to understand the knowledge, awareness, and practices of ELCC practitioners in relation to early numeracy. Because there appears to be little research on child-care programs and early numeracy practices (cf. Blevins-Knabe, Berghout, Musun, Eddy, & Jones, 2000), we surveyed a large sample of ELCC practitioners to gather information about

their programs, common practices, beliefs, and knowledge regarding early numeracy. The results of this survey will help to engage and facilitate the use of evidence-based practice for the ELCC community (Buysse et al., 2006).

Part II: Development of the Survey

Along with parents, ELCC practitioners are responsible for the depth, range, and extent of children's early experiences with numeracy, literacy, and language. In many families, it is common for both parents to be employed outside of the home: Approximately half of all Canadian children under the age of five spend some of their time in the care of individuals other than their parents (Bushnik, 2006; see also Clements, 2004a; Green et al., 2006). It is also important to note that many parents place their children in a preschool or a playgroup to socially or academically prepare their children for school, regardless of their *need* for childcare. Considering the substantial amount of time that many children spend in out-of-home childcare, it is reasonable to assume that the practices adopted by ELCC practitioners may strongly influence skill acquisition in young children (Clements, 2004b). Accordingly, parents rate the school experience as second only to their own influence on their children's development, suggesting that parents feel ELCC practitioners are very important (Musun-Miller & Blevins-Knabe, 1998).

Children enter formal education with large differences in mathematical preparation (Aunola et al., 2004; Desoete & Grégoire, 2006; Jordan et al., 2007). Thus, it is natural to assume that at least some children acquire mathematical knowledge and skills from parents and ELCC practitioners prior to entering Grade 1. Prior to the current study, little research to date has examined the pedagogical role of ELCC practitioners in early numeracy acquisition (Bjorkland, Hubertz, & Reubens, 2004; Blevins-Knabe et al., 2000; Young-Loveridge, 2004). According to Ginsburg et al. (2008) early childhood teachers spend less time on mathematics than on literacy activities; but more generally, emphasis is placed on social, emotional, and physical development, with relatively little emphasis on cognitive development or academic preparation. Thus, the goal of most early childhood practitioners is to prepare children to be physically,

socially, and emotionally competent to succeed in school. On this view, acquiring early literacy and mathematics knowledge and abilities is typically not the goal of early childhood education (Ginsburg et al., 2008).

The primary goal of this project was to obtain detailed information about the practices, knowledge, and beliefs of ELCC practitioners, specifically with respect to early numeracy. To provide a context and a comparison, we also asked about practices, knowledge, and beliefs related to early literacy. Some questions about social and emotional factors were included to reduce the bias of the survey and to signal that we recognized the importance of those skills. However, the survey was presented as being mainly about early numeracy.

We were interested in the literacy and numeracy practices of ELCC practitioners. Based on the literature, we hypothesized that these practices may be related to other factors, such as years of experience, education level, ELCC practitioner knowledge, beliefs and attitudes, and availability of professional development. Thus, the survey was designed to assess ELCC practitioners' demographic information, education level, beliefs, knowledge, practices, and professional development. The following section describes the rationale for the questions and the content of the survey in more detail.

Demographics, Program Characteristics, and Professional Development

Background Research

Smith (2003) identified several factors that might influence or be related to teachers' practices with respect to mathematics: teacher knowledge, self-efficacy beliefs about mathematics, attitudes (such as whether mathematics is important), professional development opportunities, and perceived levels of preparation.

Education and experience. Early childhood teachers' beliefs regarding education are influenced both by their professional training and by their personal experiences working with children (Charlesworth et al., 1993; Kowalski et al., 2001; Wang et al., 2008). Wang et al. (2008) found that Chinese teachers with higher levels of education were found to agree more with child-initiated learning and disagree more with teacher-directed instruction, as compared to those with lower levels of professional training, although the sample of American teachers did not show these relations. In contrast to Wang et al.'s findings, however, Kowalski et al. (2001) found that among American preschool teachers, those with higher levels of education tended to place more importance on socio-emotional development, although this was not significantly related to their level of teaching experience. Given the variability in the existing research, we did not have any strong predictions about potential relations among respondents' education, experiences, and aspects of their knowledge, practices, and beliefs.

Of course, ELCC practitioners are trained to provide relevant early learning experiences for children, so we might expect that, compared to parents, ELCC practitioners may have a better understanding of relevant early experiences (cf. Blevins-Knabe et al., 2000). However, the minimal existing literature on early numeracy (and a preliminary examination of several college websites) suggests that even within college programs, there may be little information about early numeracy available for ELCC practitioners to use in their work. Thus, even if early numeracy is viewed as important, ELCC practitioners may have very little information about what activities to foster.

This possibility is supported by our research on the knowledge and awareness of numeracy of elementary school teachers. In our longitudinal study of children's numeracy development, we have surveyed teachers of Kindergarten through Grade 5 children. Skwarchuk

and colleagues (submitted), in a survey of 40 elementary school teachers, found that although 96% of the teachers felt that mathematics was just as important as reading in the elementary grades, only 30% felt that their university education courses had prepared them well for teaching mathematics at the primary level, despite mathematics methods courses being a required component of most, if not all, teacher training programs. Further, 100% of the respondents agreed that experienced primary teachers require ongoing professional development in teaching mathematics. These data raise the issue of whether ELCC practitioners feel prepared to provide early numeracy experiences for their students, and whether there are professional development opportunities that target early numeracy.

Teacher training has an important influence on the quality of childcare (Howe & Jacobs, 1995). In order to provide future teachers with adequate resources and information regarding appropriate early numeracy activities, the focus should be on the quality of training and not necessarily on years of education received (Ginsburg et al., 2008). In particular, specialized programs in early childhood education at the post-secondary level may be an important way to improve childcare quality (Howe & Jacobs, 1995).

In contrast, the presence of an ELCC practitioner with an undergraduate degree, even with a major in early childhood education, is not a good predictor of children's later academic achievement (Ginsburg et al., 2008). Undergraduate programs may not provide prospective teachers with the necessary knowledge and skills to teach mathematics to young children (Ginsburg et al., 2008). For instance, 80% of post-secondary early childhood programs in New Jersey offer training and coursework in literacy, whereas only 16% offer coursework in mathematics. For educators to be able to teach math, the quality of teacher training needs to be

improved, and post-secondary institutions should offer more courses and opportunities to learn about early mathematics education (Ginsburg et al., 2008).

Research indicates that there are differences in teachers' beliefs and practices based on the children's socioeconomic status (SES). Teachers of middle class children emphasized socio-emotional development, whereas teachers of low-SES children tended to place more importance on learning basic skills and academic content (Ginsburg et al., 2008; Lee & Ginsburg, 2007; Stipek & Byler, 1997). Lee and Ginsburg (2007) conducted a study with pre-kindergarten teachers. Half of the teachers taught low-SES children, and half taught middle-SES children. According to the results, teachers of low-SES children scored higher on goal-based education and demonstrated a strong focus on math. Meanwhile, teachers of middle-SES children scored higher on flexibility to meet the child's needs, child-initiated, and child-centered beliefs. These differences in teachers' beliefs may be due to differences in their goals for children of varying SES. Early childhood teachers of economically disadvantaged children have tended to emphasize academic preparation for kindergarten, viewing direct instruction of basic skills and academic knowledge as significantly more important goals than do teachers of middle-class children (Ginsburg et al., 2008). On the other hand, teachers of middle-SES children value positive feelings toward mathematics and academics as a more important component of kindergarten preparation than actual math knowledge or abilities (Ginsburg et al., 2008). For young middle-class children, math is introduced through free play, discovery learning, and exploration, although this does not guarantee that the child will develop math skills (Ginsburg et al., 2008; Lee & Ginsburg, 2007). An important issue is to understand how children's SES shapes teachers' beliefs and goals, and thus the type of education they receive.

Within the United States, economically disadvantaged children perform more poorly on numeracy and mathematics tasks than children from more affluent families (Denton & West, 2002). This discrepancy could have an impact on what the teacher believes that children should know before kindergarten. Teachers of low-SES children may believe it is their responsibility to prepare children academically so that they do not lag behind middle-SES children upon entering kindergarten (Ginsburg, Lee, & Boyd, 2008). In contrast, teachers of middle- or upper-SES children may presume that highly educated parents engage in literacy and numeracy activities at home, whereas the teacher's responsibility is to help the child become socially and emotionally well-adjusted, thus prioritizing socio-emotional functioning above numeracy development. However, teachers of middle-SES children have expressed feeling pressured by parents to provide more structured instruction on academic knowledge and basic skills oriented activities, even though these practices are incongruent with their beliefs (Lee & Ginsburg, 2007; Stipek & Byler, 1997). Some teachers have also mentioned school and state policies to be sources of pressure to increase focus on academics, which do not always allow teachers' practices to be consistent with their beliefs (Stipek & Byler, 1997). Individuals involved in training early childhood educators tend to come from middle-class backgrounds and are typically well educated, and therefore may not fully understand the need to academically prepare children of low SES, even though it is important to acquire these skills at an early age (Stipek & Byler, 1997). Although similar studies with Canadian educators have not been reported, we assumed that similar pressures and considerations might be present as in these American samples.

These findings suggest that early childhood practitioners may need more training in early numeracy, specifically, more knowledge of a greater range of practices, concrete activities, or strategies that can be used to facilitate the development of early math abilities (Kowalski et al.,

2001). Despite recent changes to standards and curriculum guidelines for mathematics instruction, Clements (2004a) notes, "at present, most teachers and caregivers do not know what to do about mathematics for the young children with whom they work" (p. *x*).

Presumably, experiential factors such as length of time in the profession, type of child care or educational setting, and education might also be relevant for understanding the participants' responses. We hypothesized that, for ELCC practitioners, their reports of early numeracy practices will be related to knowledge about early numeracy development, to education, to professional development, and ultimately to their beliefs that early exposure to numeracy concepts is important. Self-efficacy beliefs about their own mathematical skills might also relate to reported practices, as was reported by Musun-Miller and Blevins-Knabe (1998) for parents of preschool children.

Most research on childcare has been conducted with samples from the United States, and little is known about child care practices in Canada (Howe & Jacobs, 1995). However, given the extensive demographic differences between the American and Canadian populations, United States-based research may not be applicable to Canadian childcare practices and the education of Canadian children. More research needs to be done to investigate children's math development within the Canadian context. According to Howe and Jacob's (1995) model of child care quality, there is a relationship between teacher education and licensing/regulation, both of which have an impact on child care quality, thus influencing children's developmental outcomes. This must be interpreted within a Canadian framework, which shapes licensing/regulation and teacher education through prevailing attitudes, social policies, and laws that directly or indirectly relate to childcare.

Current Survey

The demographic component of the present survey was designed to gather information about the practitioners so that we could both describe the sample adequately and link demographic factors (such as years of experience) to survey responses. Years of experience and level of education have been linked to ELCC beliefs and practices in past research (Charlesworth et al., 1993; Kowalski et al., 2001; Wang et al., 2008). Respondents were asked to indicate their age, gender, and postal code; years of experience in the profession; their current work situation, including years of experience and role in the current job; and program philosophy. Participants also reported their level of education, frequency of enrollment in various professional development (PD) workshops, and awareness of local PD workshops. ELCC practitioners may value numeracy and literacy instruction, but feel ill-equipped to provide instruction in these areas if they have not received much training.

Because ELCC practitioners have demonstrated different practices in relation to SES of children in past research (Ginsburg et al., 2008; Lee & Ginsburg, 2007; Stipek & Byler, 1997), practitioners were also asked to think of their program and estimate what percentage of the children fell in a variety of categories that are generally considered to be disadvantaged.

Knowledge

Background Research

Teacher knowledge has been identified as one factor that may influence or be related to teachers' practices with respect to mathematics (Smith, 2003). Thus, we were interested in the knowledge ELCC practitioners have about children's development. At the early elementary level, many teachers are unaware of the mathematical capabilities of the students in their classrooms, particularly of the intuitive knowledge that children acquire outside the school

setting (e.g., Crespo, 2000; Peterson, Fennema, Carpenter, & Loef, 1989). Thus, we hypothesized that ELCC practitioners would display a similar pattern in their knowledge of children's mathematics; more specifically, we predicted that they would underestimate children's capabilities in numeracy-related activities. Given the emphasis on literacy training over the last ten years, we expected ELCC practitioners to be fairly accurate in their estimations of children's early literacy capabilities.

Furthermore, it is reasonable to assume ELCC practitioners will not facilitate learning in areas that they feel are developmentally inappropriate for children. Thus, we hypothesized that respondents would not engage in practices if they did not think children (at a given age) were not capable of those activities, or that the underlying skills were beyond the child's ability. To assess knowledge, we designed a question in which respondents indicated the age that they felt children were capable of certain activities.

It seems quite plausible and reasonable that practitioners would not engage children in numeracy activities that if they felt those activities were beyond the children's capabilities. Thus, we phrased the knowledge question in terms of the capabilities of children at certain ages. When we analyzed the data, therefore, we connected the knowledge questions to reported practices. Our hypothesis was that individuals who believed children were capable at an earlier age would be more likely to report more advanced early numeracy activities (Ginsburg et al., 2008).

Current Survey

To assess the knowledge of ELCC practitioners about children's development in the areas of numeracy and literacy, the respondents indicated an age range during which they believed most children are capable of the activity described by a series of statements. The statements

related to numeracy were constructed according to the literature showing children's thinking in several broad areas: counting and enumeration, comparing and ordering (specifically, using ordinal terms), geometry, and simple arithmetic (e.g., addition and equal partitioning). For literacy, statements were drawn from the Language and Literacy milestones described by Millard and Waese (2007). Two additional more advanced statements were included to compare with the numeracy statements. For advanced literacy, respondents were asked to rate the age at which children are capable of using invented spelling to print words and of reading and understanding simple words (e.g., red, car). In Canada, provinces with Kindergarten curricula for five-year-olds expect children to be reading "patterned and simple texts" by the end of the Kindergarten year (Ontario Ministry of Education, 2006). Norms for word reading tests standardized for North America begin at age five (Woodcock). Thus, we would expect Canadian ELCC practitioners to rate reading and invented spelling as within the capabilities of five-year-olds.

Counting and Enumeration. Respondents indicated the age range at which children are able to (a) count from 1 to 10, (b) count backward from 5, (c) state the number after 5 by starting the count from 1, and (d) state the number after 8 by starting the count from 1. Research has shown that before the age of 4, most children can recite the oral counting sequence from 1 to 10 (Baroody, 2004; Clements, 2004b; Fuson, Richards, & Briars, 1982; Ginsburg & Russell, 1981). Researchers have also found that before 4 years of age, most children are able to state the number word after any number from 2 to 9 by either starting the count from 1 or by being given a "running start" (Baroody & Ginsburg, 1983). Finally, studies have demonstrated that by the time children are 4 years old, most are able to count backward from 5 (Baroody, 2004; Fuson, et al., 1982; Baroody & Ginsburg, 1983), although some have argued that this competency appears later, between the ages of 4 and 5 (Clements, 2004b).

Another statement required participants to rate the age at which children are capable of accurately enumerating a set of 4 items in a collection. Research has demonstrated that by the time children are 5 years old, they can accurately count up to five items (Baroody, 1987), often without touching or moving the items (Clements, 2004b). Some research indicates that by the time they are in kindergarten, children are able to accurately enumerate up to 10 and even 20 items (see Baroody, 2004; Fuson, 1988).

Comparing and Ordering. The participants were asked to rate the age at which children are capable of identifying the "first person in line." The research suggests that children's knowledge of ordinal terms develops relatively early. Between the ages of 2 and 3, children develop the ability to identify the first and last item in a series (Clements, 2004b).

Geometry. One item required the respondents to indicate the age they believed children were capable of recognizing and naming triangles, squares, and circles. A considerable amount of research has examined young children's ability to recognize and typical geometric shapes. For example, Fuson and Murray (1978) estimated that more than half of all 3-year-old children could name a circle, square, and triangle. In another study, when triangles, squares, and circles were presented with a variety of other shapes, including parallelograms and rhombuses, 4-year-old children could correctly identify a circle 92% of the time, a square 82% of the time, and triangles 60% of the time (Clements, Swaminathan, Hannibal, & Sarama, 1999). With a sample of 5-year-old children, Klein, Starkey, and Wakeley (1999) reported that more than three-quarters of them could name a circle, almost 80% of them could name a square, and 80% of them could name a triangle. Thus, knowing shape names should be within the capabilities of many three and most four-year-olds.

Early Arithmetic. With respect to the age at which children develop basic concepts of arithmetic, we included one item on knowing a doubles fact (i.e., knows that 2 and 2 are 4) and another on the ability to evenly distribute 8 items between two people. Mastery of counting skills, such as knowing the "number after" and the "number before," is related to the development of simple arithmetic concepts, such as adding and subtracting (Baroody, 1987). More exposure to counting and enumeration activities helps children to extend such knowledge. By the time they are five years old, most children know the doubles facts to 10 (i.e., two and two is four, three and three is six, etc; Clements, 2004b; see also Carpenter, Fennema, Franke, Levi, & Empson, 1999). Furthermore, children at young ages learn ways to distribute objects evenly among two or more people; Clements (2004b) stated that children as young as three years of age are able to divide a small set of objects into two equal subgroups; between the ages of 4 and 5, children develop more sophisticated strategies for distributing larger collections of items among two or more people (Carpenter, Ansell, Franke, Fennema, & Weisbeck, 1993; Frydman & Bryant, 1988). Thus, both arithmetic skills we asked should be within the capabilities of many four- and most five-year-olds.

Beliefs

On the assumption that practitioners' beliefs and their knowledge about development of children's literacy and numeracy skills would be relevant, we developed several different questions to assess these factors.

Background Research

Previous studies have indicated that early childhood educators tend to place more importance on socio-emotional development than on building academic skills (Brown, Molfese, & Molfese, 2008; Kowalski et al., 2001). Blevins-Knabe et al. (2000) reported that homecare

providers rated math knowledge as significantly less important for children to acquire before kindergarten than social skills, pre-reading skills, and expressive language. In a second study, both parents and home care providers reported that they infrequently engaged in numeracy-related activities (like counting or comparing quantities; Blevins-Knabe et al., 2000). Thus, we hypothesized that the ELCC respondents would find early numeracy practices and knowledge less important than similar early literacy skills, and less important than social and emotional milestones.

When discussing early learning practitioners' beliefs, it is imperative to consider the DAP philosophy because it has had a major impact on the field of early childhood education and is the dominant approach to educating young children (McMullen et al., 2006). Research indicates that preschool teachers consider activities involving traditional academic content less important than other activities, implying that they place less emphasis on activities associated with printing letters, working with numbers, and developing academic skills (Brown et al., 2008; Kowalski et al., 2001). On this view, ELCC practitioners may reject both literacy and numeracy practices associated with basic-skills orientation as developmentally inappropriate and therefore reject the content of learning that specifically fosters the academic skills.

To assess the beliefs of ELCC practitioners, Stipek and Byler (1997) used two belief scales--child-centered and basic-skills based-- with preschool, kindergarten, and first-grade teachers. They found that practitioners' responses to the two scales were negatively correlated, meaning that the more teachers endorsed child-centered beliefs, the less they endorsed basic skills. Previous research has shown significant associations among practitioner beliefs, goals, and practices (Stipek & Byler, 1997; Charlesworth et al., 1993; McMullen et al., 2006; Stipek & Byler, 1997; Vartuli, 1999; Wang, et al., 2008). For example, McMullen et al. (2006) found that

preschool teachers who often engaged the children in play and other child-directed activities tended to report beliefs consistent with the DAP philosophy. On the other hand, those who commonly engaged in more structured instruction and teacher-directed learning tended to hold beliefs that were more in line with a traditional or basic skills orientation.

Similarly, Wang et al. (2008) found a moderate association between preschool teachers' beliefs and practices. In their Chinese sample, beliefs endorsing child-initiated learning and a social-cultural curriculum were positively correlated with child-initiated, creative, and manipulative activities, while beliefs endorsing teacher-directed learning and basic school skills were significantly correlated with basic skills practices (see also Charlesworth et al., 1993).

Stipek and Byler (1997) found a significant correlation between reported beliefs and observed practices among preschool and kindergarten teachers, although no such relationship was found for first-grade teachers. Child-centered beliefs were associated with a positive social climate and less emphasis on basic skills, while the opposite was found for basic-skills oriented beliefs. These results suggest that preschool and kindergarten teachers viewed the DAP and basic skills approaches as incompatible and needed to subscribe to one set of strategies, whereas first-grade teachers were able to embrace both theories. First-grade teachers may use different approaches to fulfill different learning goals (Stipek & Byler, 1997). Therefore, it is also important to explore early childhood educators' goals for their children and how these are associated with their beliefs and practices. More generally, it is important to consider the goals that teachers of children in various situations (i.e., child care, preschool, kindergarten, Grade 1) consider important. A teacher who believes that her role is to develop socio-emotional skills is unlikely to report practices that foster academic skills, even if she believes that children need to learn academic content.

Teachers' goals have been found to be congruent with their practices in the classroom (Stipek & Byler, 1997). Teachers who promote basic skills tend to view basic skill acquisition as an important goal, placing value on knowledge and facts as important priorities and independence and self-concept as relatively unimportant goals, whereas those who emphasize child-centered practices are more likely to think of self-concept as a significant priority and basic skill acquisition as irrelevant (Stipek & Byler, 1997). Kowalski et al. (2001) found that preschool teachers rated literacy and numeracy items similarly, whereas socio-emotional functioning was rated as significantly more important, suggesting that early childhood educators view the attainment of socio-emotional skills as an essential component of preschool education, whereas the development of academic skills has a lower priority.

Although researchers have found that DAP and basic skill orientations are negatively correlated, that is not a necessary relation (e.g., Green et al., 2006). Findings concerning the benefits of reading books to children illustrate how practices can be both developmentally appropriate and support cognitive skill development – specifically the acquisition of vocabulary. Adults who use shared reading (i.e., the adult reads aloud to the child or children) in combination with specific strategies can greatly enhance children's acquisition of new vocabulary through storybook exposure (Mandel, Osana, & Venkatesh, 2008; Sénéchal, 2006; Sénéchal & LeFevre, 2002; Sénéchal et al., 1996). Importantly, shared reading is viewed as developmentally appropriate and child centered, but it also fosters a variety of important skills, including focused attention and vocabulary. Further, it is relatively inexpensive to implement and children (and adults) love it. Accordingly, shared reading as a context for developing cognitive skills and increasing academic preparation has become widely accepted and valued in early childhood education (Evans & Shaw, 2008). From our perspective, it represents an important point of

contact that shows how DAP can intersect with the goal of enhancing children's preparation of literacy and numeracy instruction.

Another reason early childhood practitioners may not engage in numeracy practices is that they may not be well prepared to identify everyday opportunities to teach math that arise from the child's spontaneous interest and readiness to learn more sophisticated concepts (Ginsburg et al., 2008). They may not be aware of how to deliver numeracy content using developmentally appropriate practices. A related possibility is that teachers do not spend much time on early numeracy activities because they are afraid of math, or they do not like it (Ginsburg et al., 2008).

Finally, although some teachers may believe early numeracy is important, educators may not how to put their values into practice (Kowalski et al., 2001). This possibility is consistent with findings indicating that parents have little awareness of numeracy activities and that they engage in numeracy activities with their children much less frequently than literacy activities (LeFevre et al., in press). Parents often endorsed the view that numeracy was important (see also LeFevre, Clarke, & Stringer, 2002), but seemed to have little knowledge of what kinds of activities might be helpful in enhancing early numeracy skills in young children (see also Musun-Miller & Blevins-Knabe, 1998). These findings contrast with those on parents' early *literacy* practices, where the vast majority of parents report reading to their children on a daily basis and, by the time their children are 4 and 5 years old, report that they often teach them to read and write letters and words (Sénéchal et al., 1996; Sénéchal, LeFevre, Thomas, & Daley, 1998; Sénéchal & LeFevre, 2002). These studies suggest that parents' confidence both in their own abilities and in implementation of relevant home experiences will be important in

determining whether they provide numeracy experiences. We hypothesize that similar factors will also influence ELCC practitioners.

Current Survey

To assess beliefs, we included a section in which the respondents were asked to rate their agreement with a variety of statements designed to reflect 'child-centered' or 'basic skills' orientations, as reflected in the literature. In some cases, however, we reformulated the questions to allow for the independence of these two perspectives.

Additionally, ELCC practitioners were asked how important they felt it was for children to reach specific benchmarks before starting Grade 1, thus potentially indicating what they believed they should be teaching children in early childhood programs. For example, they were asked to indicate how important it is for children to know all the 26 alphabet letters before they start Grade 1. We have used the Benchmarks items in previous research with parents (LeFevre, et al., 2002; LeFevre et al., in press). Parents tend to rate all of the benchmark items very highly, but they rate numeracy benchmarks as less important than literacy benchmarks. Given the disparity between parent and teacher beliefs seen in previous studies (Knudsen-Lindauer & Harris, 1989), we hypothesized that ELCC practitioners would attribute less importance to these benchmarks than parents have in previous studies.

ELCC practitioners were also asked to indicate if they felt their program included the right amount of early numeracy and early literacy activities. This question was designed to probe practitioners' overall beliefs about the literacy and numeracy content of their early childhood programs. We also asked ELCC practitioners about their level of awareness of numeracy and literacy by asking them if they felt knowledgeable in these areas. As a way of examining their attitudes towards numeracy and literacy, practitioners were also asked if they avoided situations

involving mathematics or writing (see Question 9 in Appendix E for more details). These questions about their personal attitudes towards mathematics and writing have proven useful in understanding parents' practices (LeFevre et al., in press). Parents who are more positive about mathematics were more likely to report encouraging their children to practice arithmetic at home (LeFevre et al., in press). Thus, we hypothesized that an individual's personal attitudes may influence his or her practices above and beyond more general beliefs about the importance of numeracy and literacy in early childhood education.

Practices

The central question of this project was what ELCC practitioners report doing with regards to early numeracy. In a preliminary search of the literature about the numeracy-relevant awareness, knowledge, or practices of ELCC practitioners, few directly relevant papers were identified. Thus, we hypothesized that ELCC practitioners may report numeracy activities less frequently than literacy activities, in part because they may view numeracy as less important than literacy. Given this hypothesis, our first step was to address the question of how children's early numeracy experiences could be supported in childcare settings. This information will allow for the effective design of research aimed at maximizing the benefits for young children in regards to early numeracy experiences.

Background Research

Although there is research suggesting that early numeracy experiences are important in shaping children's readiness for mathematics learning in school (e.g., Aunola et al., 2004), we did not know if ELCC practitioners share this view. As mentioned above, some research has shown that early childhood educators spend more time teaching literacy than math skills, indicating that they view early numeracy as less important than literacy (Baroody et al., 2006;

Ginsburg et al., 2008). Despite the importance of numeracy experiences in early childhood education, we hypothesized that awareness of the importance of early numeracy experiences and awareness of what constitutes 'early numeracy' may be minimal among ELCC practitioners. This hypothesis is based in part on our recent work (e.g., LeFevre et al., in press), which indicated that parents have little awareness of numeracy activities and engage with their children in numeracy activities much less frequently than literacy activities.

There are only a few published reports that specifically target the practices of childcare practitioners with respect to early academic skills. In an approach that was similar to that used in the present research, Green et al. (2006) investigated the extent to which early childhood educators encouraged literacy, and examined the features of childcare programs that were associated with increased levels of literacy and language promotion. Early childhood educators (N=180) who were employed in childcare centres completed a survey during regional training sessions. Overall, the results indicated that many early childhood educators were attempting to incorporate literacy and language activities into their daily routines. Most practitioners reported that they read aloud to the children in their care each day and used interactive methods that allowed children to ask questions and talk about the book. Most respondents reported making books and other reading material available in the classroom, thus allowing children to gain exposure to print. Most ELCC practitioners also reported that they attempted to teach children to understand the relationship between letters and sounds, and taught children to recognize the letters of the alphabet and their corresponding sounds. Many practitioners also engaged children in writing activities. To promote phonemic awareness, they selected books that contained rhyming, alliteration, or nursery rhymes, and children were often encouraged to make up their own rhymes. Children were often taught about the conventional features of books, such as the

fact that words on a page are read from left to right and from top to bottom. Notably, however, although overall responses suggested that most ELCC practitioners are engaging in literacy activities, the authors also note that a substantial minority of teachers reported doing these activities very little or not at all.

Green et al. (2006) used multiple regression to determine if specific characteristics of the ELCC practitioners or programs were related to frequency of literacy and language activities. One of the strongest predictors of literacy and language activities was access to print materials. ELCC practitioners' confidence in their ability to teach literacy was also predictive of language and literacy activities in childcare programs. In summary, there is evidence that ELCC practitioners value literacy-related activities and attempt to incorporate those into their practices, suggesting that they believe children should acquire literacy-related skills. No similar research on early numeracy was identified in our literature review, however.

Current Survey

Based on the existing literature and our determination to provide an appropriate context for the survey, we formulated a list of literacy and numeracy practices that would be developmentally appropriate (up to 5 year olds) and likely to occur in a childcare setting. ELCC practitioners were asked to indicate how often they engaged in specific practices (activities) with children in their care. For example, respondents indicated how frequently they asked questions while reading, drew attention to comparisons (e.g. smaller, larger), and engaged in songs or games (see the survey in Appendix E for more information). Two lists of practices were developed—one for Infants and Toddlers, and another for Preschool or School-Aged children. The two lists of practices were developed because it was assumed that activities would differ considerably depending on the age group, as many practices appropriate for infants and toddlers

would not be appropriate for preschool and school-aged children, and vice versa. Respondents were asked with which age group they spent the most time, and were then directed to the appropriate list of practices (either Infant and Toddler *or* Preschool and School-Age).

Items for the Practices lists were developed using a review of current literature focusing on ELCC practices or activities reported by parents (Bracken & Fischel, 2006; Charlesworth, et al., 1993; Charlesworth & Lind, 1999; Stipek & Byler, 1997, 2004; Vartuli, 1999). A priori, practices were categorized as 'Basic' (i.e., most practitioners would likely perform fairly frequently) or 'Advanced' (i.e., more complex, less frequent activities) in order to ensure that we would have a range of possibilities. Pilot testing helped direct the balancing of the set of basic and advanced Literacy items with a set of basic and advanced Numeracy items. Five practices related to Emotional development were included to provide a more complete view of ELCC practices.

ELCC practitioners were also asked to complete open-ended questions, describing a successful literacy activity, a successful numeracy activity, and literacy and/or numeracy activities they have "stopped doing because they weren't enjoyable or successful". These qualitative questions were designed to provide insights into which practices ELCC practitioners have found to be effective. We hoped that information about effective activities would be gained through this process, which could then be transmitted back to the ELCC community.

Part III: Methods

In this section, we describe in detail the components of the survey. The components are described in the order in which they were presented to the participants. Note that demographic information was included first on the survey because it would be difficult to interpret responses without knowing something about the respondents, and if left to the end of the survey, these questions were less likely to be answered. We were cognizant of timing issues and initially attempted to keep the survey to between 5 and 10 minutes in length (on average). However, there is an obvious tradeoff between length and depth of information, and so we designed the survey to require approximately 15-20 minutes by someone working reasonably quickly through the items. In the Results, we will address the issue of how long the survey took to complete and the potential implications in interpreting the findings.

Survey Design and Presentation

Most survey participants filled out an on-line version of the survey. The SurveyMonkey™ web survey tool was used to create, access, and store the survey data. A French translation of the survey was mounted as a separate survey within the SurveyMonkey site. Clicking the link to the survey brought up an initial consent page and a description of the purpose of the survey. Participants were informed that their responses would remain anonymous and confidential, and contact information was provided for anyone with ethical and/or survey concerns. Participants were also made aware of the incentive draw, which would be offered at the end of the survey, and of the opportunity to receive a copy of the final report. To preserve anonymity, both of these opportunities were offered via a separate web link. In order to proceed to the survey, the participant had to click the Agree checkbox under the statement: "I consent to participate in the Early Learning & Child Care Practitioner Survey."

Each survey page displayed a progress bar, showing the percent of the survey completed. Next Page and Previous Page buttons were available at the bottom of each page. Pages were designed to minimize the need for scrolling. At the top of each page, an Exit Survey button was displayed at all times.

Some participants (n =187) filled out a paper version of the survey that was distributed in Vancouver and Winnipeg at conferences for childcare practitioners. The paper version was modified slightly from the web version to replace scroll-down menus and other web features with printed items.

Survey Content

The web survey was divided into sections during the design process, although these sections were not displayed to the user in the final survey. Each of the sections contained items oriented to specific research goals of the study. Most sections contained a balance of literacy and numeracy items. The main sections are outlined below, with some details about the items they contain.

Demographics

Location and experience. Respondents were asked for their postal codes as an indication of geographic location in Canada. ELCC practitioners completed questions providing their age, gender, level of education, and years of experience in the child care field. Respondents were also asked about their current role (e.g., director or administrator versus someone working directly with children), percentage of time spent working with children, and years in this role.

Program information. ELCC practitioners provided information about their current programs, such as program philosophy (e.g., Montessori, Reggio Emilia, High Scope), type of facility (e.g., private building versus part of a school), and program composition in terms of

children with English as a second language, aboriginal children, children with special needs, subsidized positions, and children living in poverty. Respondents indicated the percentage of children within each of these categories by selecting one of the following responses: None, 1-25%, 26-50%, 51-75%, 76-100% or Don't Know; see Appendix E for more details.

Professional development. Respondents were asked about their awareness of local professional development offerings. They were also asked about the frequency of their own enrollment within the last two years in literacy, numeracy, social/emotional, and other professional development initiatives, and student status. Respondents indicated whether they had attended a type of professional development "Not at all," "Once," "Twice," or "Three times or more" during the last two years.

Knowledge

To assess knowledge of child development, ELCC practitioners were asked to rate the age range at which most children are capable of performing specific activities. ELCC practitioners selected one of the following for each item: Before age 4, Age 4 until Age 5, Age 5 until Age 6, or Age 6 and up. There were nine numeracy-related items balanced by seven items for literacy-oriented capabilities. Items included: "Can accurately count 4 items in a collection," "Makes up rhymes, including nonsense rhymes and chants," and "Knows how to fairly distribute 8 candies between 2 people." Question 9 also assessed participant's feelings about the sufficiency of their knowledge of early literacy and numeracy.

Based on previous research (LeFevre et al., 2003; in press), two indicator items were included in Question 9 to assess participants' comfort level with mathematics and advanced literacy (e.g., writing). The items are identically phrased: "I often avoid situations involving mathematics" and "I often avoid situations involving writing." Respondents indicated their level

of agreement with these statements on a five-point scale. LeFevre et al. (2003) found that adults who agree that they avoid math tend to have poorer arithmetic fluency skills (i.e., speed and accuracy of simple arithmetic).

Two of the items in the Beliefs section described above could also reflect the ELCC practitioner's knowledge. These items were "Reading stories with children is the best way for them to learn to read" (Vartuli, 1999) and "The focus of early numeracy is counting, not math."

Beliefs

To assess beliefs, practitioners were presented with a set of eight statements describing the goals and types of instruction within their respective early childhood programs, with an accompanying five item Likert-type scale, coded as –2: strongly disagree; -1: disagree; 0: neither agree or disagree; 1: agree; and 2: strongly agree. Some of the statements were derived from the existing studies cited above. A balance of four child-centered items and four academic, basic-skills items were presented. Given the passage of time and the predominance of the child-centered orientation in Canada, items were framed to use more modern language than seen in previous research. For example, Stipek and Byler (1997) included the belief item "Children should be given formal instruction in number skills; even if they show little interest in them." This item was reframed as "Formal instruction in math and reading should only be given if children want it." Other examples of items include: "Children should be allowed to opt out of literacy and numeracy activities (Stipek & Byler, 1997)," "All activities in a program should be child-initiated (Vartuli, 1999)," and "The focus of early numeracy is counting, not math" (see Question 11 of Appendix E for the complete question).

Additionally, ELCC practitioners were asked how important they felt it was for children to reach specific benchmarks before starting Grade 1. These benchmarks were originally created

and used with parents in LeFevre et al. (2002). Four literacy-related benchmarks were included, along with three numeracy-related benchmarks. Each set ranged from very low expectations (e.g., "Count to 10"), through moderate (e.g., "Know some alphabet letters") to expectations beyond or in-line with Grade 1 curriculum guidelines (e.g., "Read a few words," "Know simple sums"). Benchmarks are a somewhat contentious issue in the context of Developmentally Appropriate Practices, because benchmarks themselves do not reflect individual differences in children's development. To attempt to assuage this concern, the stem for the Beliefs question was framed as follows: "Every child develops at his or her own rate. In your opinion, how important is it for children to achieve the following benchmarks BEFORE starting Grade 1?" Respondents were asked to rate the benchmarks on a five-point scale of importance.

Finally, ELCC practitioners were also asked to indicate if they felt their program included the right amount of early numeracy and early literacy activities. Respondents indicated whether the extent to which they disagreed or agreed that their program contained the adequate amount of these activities.

Practices

ELCC practitioners indicated how often they engaged in specific practices (activities) with children in their care. The Practices questions were based on the age of the children with whom the participant spent most of their work hours. One set of activities was oriented to Infants (under 12 months) and Toddlers (1 and 2 year olds); the other was targeted to preschoolers (3 and 4 year olds), school aged (5 and 6 year olds), and older children in after school programs (age 6+). Activities were balanced across basic and advanced literacy and numeracy items. Four Emotional/Social items were included as control measures and to increase participants' comfort level by acknowledging the importance of these activities. Items from the Infant and Toddler list

included: "I encouraged pretend or real conversations and turn taking," "I used alphabet books," and "I counted fingers and toes and food during daily life activities" (see Question 17 of Appendix E for full list of items).

Items from the Preschool and School-Aged list of practices included: "I asked who, where, and why questions while we read," "I played games that involved counting items," and "I asked children to include another child in a game or activity" (see Question 18 of Appendix E for full list of items). Participants selected responses for each practice from the following: Most days last week; At least once last week; At least one in the last month; Sometimes, but not last month; Not in the last year; or Never with this age group. ELCC practitioners were also asked to complete open-ended questions, describing a successful literacy activity, a successful numeracy activity, and an unsuccessful numeracy activity.

Randomized Questions

For some survey questions, the items were placed in random order. SurveyMonkey provides the option to randomize question items, thus generating a random order for each participant from the list of items. For the paper version of the survey, a single pseudo-random order was created the questions and used on all paper copies to facilitate coding. A table of the questions that were randomized in the web survey is provided in Appendix A.

Recruitment of Participants

Although this survey used a sample of 'convenience,' we nevertheless had access to the membership of the CCCF. Random sampling of the general population would not have been useful, as few individuals would be childcare practitioners. As in any survey, participation is voluntary. Our goal was to circulate the notice about the survey widely so as to give the opportunity for participation available to as many ELCC practitioners as possible. Our main

constraint was time – survey data had to be collected before the end of June to allow time for coding and analysis. Thus, we had a window of only three months (after survey design and ethics approval) in which to recruit respondents. For details on the each of the recruiting methods and sources, see Appendix B.

Table 1. *Sources of Survey Respondents*

Source	Count	Percent
CCCF Site Link	355	46.2
Learn link by email	81	10.6
Conference online respondents	9	1.2
Conference Paper copies	187	24.4
French respondents	39	5.1
Early May respondents (email)	97	12.6
Total	768	100

Survey Completion Rate

The introductory agreement page of the survey stated that the survey would take approximately ten minutes. Given current knowledge about web survey design, the team was aware that this was somewhat longer than desired. The trade-off was acknowledged to be the greater amount of detailed data from a smaller group of participants. As expected, the data showed that there were participants who exited from the survey well before completion or even before they had entered any data at all (these participants had clicked the 'Accept' button on the Consent page and then had exited immediately).

It was important to ensure that these potential participants had dropped out purely because of time constraints rather than because they held a particular set of beliefs that might have caused them to be uninterested in completing the survey. An initial dataset was prepared for 946 participants for whom there were partial or complete data. No significant relations were found between survey completion and education level, province, or beliefs (based on cluster analysis of the Beliefs items in the survey). Participants with complete data had a mean survey duration of

17 minutes (*SD*=10, *n*=706) while the drop-outs had a mean of about 5 minutes (*SD*=5.6, *n*=163). Thus, it seems likely that individuals who did not complete the survey ran out of time or felt that the survey was taking too long. Early in the design process, we had recognized this as a potential problem, and consciously decided to allow the survey to be longer than was really desirable. Given that the majority of people who started did complete the survey, it seems that our approach was justified because the information obtained does provide a comprehensive picture of practices, knowledge, and beliefs.

Final Sample

All further analyses were conducted on the participant sample of 768 participants with complete (n = 682) or mostly complete data (n = 86)[2]. Most of the individuals who did not complete the Practices question (n = 16) work with children only 25% of the time or less, and presumably felt unable to respond about daily activities and practices because that was not their main role in the childcare setting. Details of missing data by content area can be found in Appendix C.

[2] These individuals were missing data from a single question, typically the final long question in the survey, which asked for ages at which children are capable of achieving certain activities.

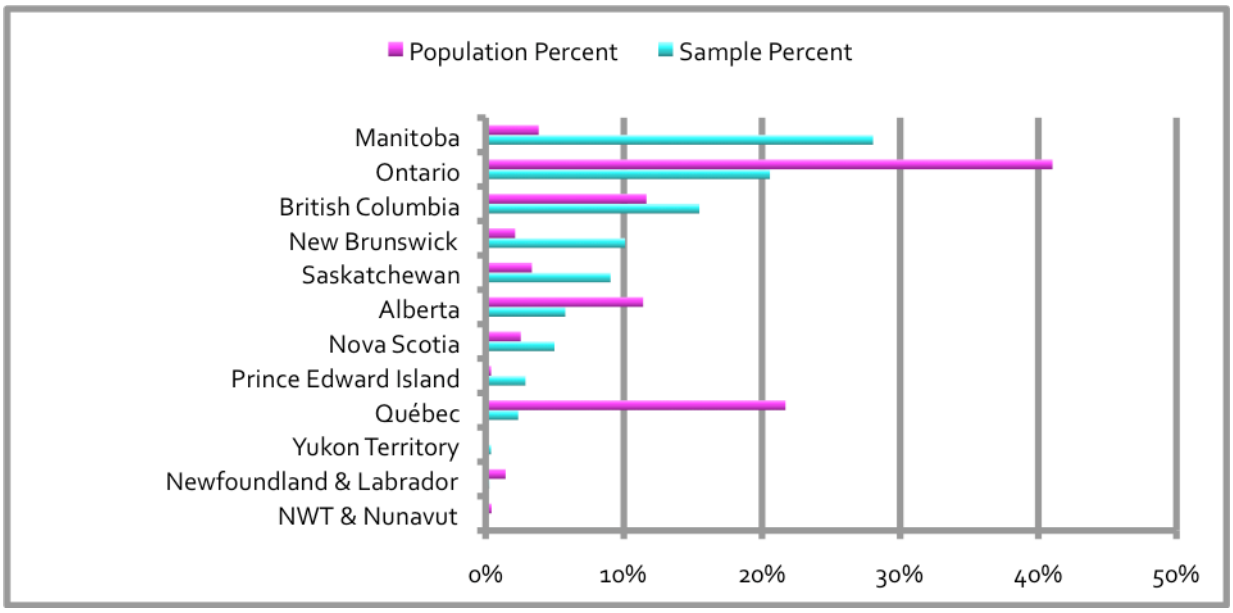
Part IV: Results

Program Characteristics

Geographic Distribution

The geographic distribution (by provinces) of the respondents is shown in Figure 1 and contrasted with the distribution of children by province (Friendly, Beach, Fern, & Turiano, 2007). Recall that the sampling strategy included advertising the survey in *Interaction* (the CCCF magazine), emailing a link to personal and professional contacts, attending child care conferences in Manitoba and British Columbia, and including a survey link in information distributed at a child care conference in Nova Scotia. This strategy was likely responsible for several characteristics of the geographic distribution. First, the overrepresentation from Manitoba and B.C. in relation to the distribution of children in those provinces probably reflected conference contacts. Concomitantly, the conference-based sampling is probably related to the under-representation from Ontario, relative to the large number of children in that province. Finally, the under-representation from Quebec is typical of CCCF survey initiatives. Given this uneven distribution, we have not attempted to interpret the survey responses in relation to geographic regions.

Figure 1. *Children per province in 2005 (Friendly et al., 2006) and the percentage of survey respondents by province.*



Location of Programs

Statistics Canada's Report on Child Care in Canada (89-599-MIE, Bushnik, 2006) states that approximately the same percentage of Canadian children aged 6 months to five years are cared for in childcare centres (28%) as are cared for in home-based programs by a non-relative (30%). As seen in Table 2 below, 18% of the participants in this survey provide care from their own homes. Thus, family childcare providers are under-represented in the sample.

Table 2. *Main categories of program locations for survey participants*

Location	Frequency	Percent
Dedicated private facility	249	32.4
School (private, elementary or secondary)	186	24.2
Community centre or church	158	20.6
Participant's Home	141	18.4
Information Missing	34	4.4
Total	768	100

Program Characteristics

Participants were asked to select the philosophy that is followed by their program. More than half of the sample selected Reggio Emilia, Emergent Curriculum, or some combination of those philosophies (55%). Another large group reported that their program did not follow a specific philosophy (30%). A small number of participants reported working in either Aboriginal Headstart program (n = 20) or another Aboriginal philosophy (n = 4).

Respondents indicated the percent of the children in their program who qualify for government-subsidized care by selecting a range (e.g., 1 to 25%). The relation between subsidies and location of program is shown in Table 3, using the four main location categories described above. Programs in dedicated childcare centres were more likely to have children with subsidies, whereas home care respondents were less like to have children with subsidies. Government subsidy rates also have a significant relation to the percentage of children in the program for whom English is a second language, $r(661) = .205$, $p = .000$.

Table 3. *Number of Participants who selected each subsidy category (i.e., the approximate percentage of subsidized children in their programs) by program location.*

	Percentage of Children in Program Receiving Subsidies					
Location	0	1-25	26-50	51-75	76-100	Total
Participant's Home	64	29	22	10	7	132
Private Dedicated Facility	13	72	61	44	38	228
Community centre/church	15	26	36	29	27	133
School (private or public)	13	58	40	22	29	162
Total	105	185	159	105	101	655

Summary

In summary, the respondents represent a range of geographic locations, types of programs, and program locations. Thus, the sample was not necessarily representative of the actual (real) distributions, but it did draw respondents from a variety of situations and circumstances.

Characteristics of Survey Respondents

Gender, Employment Roles, and Education

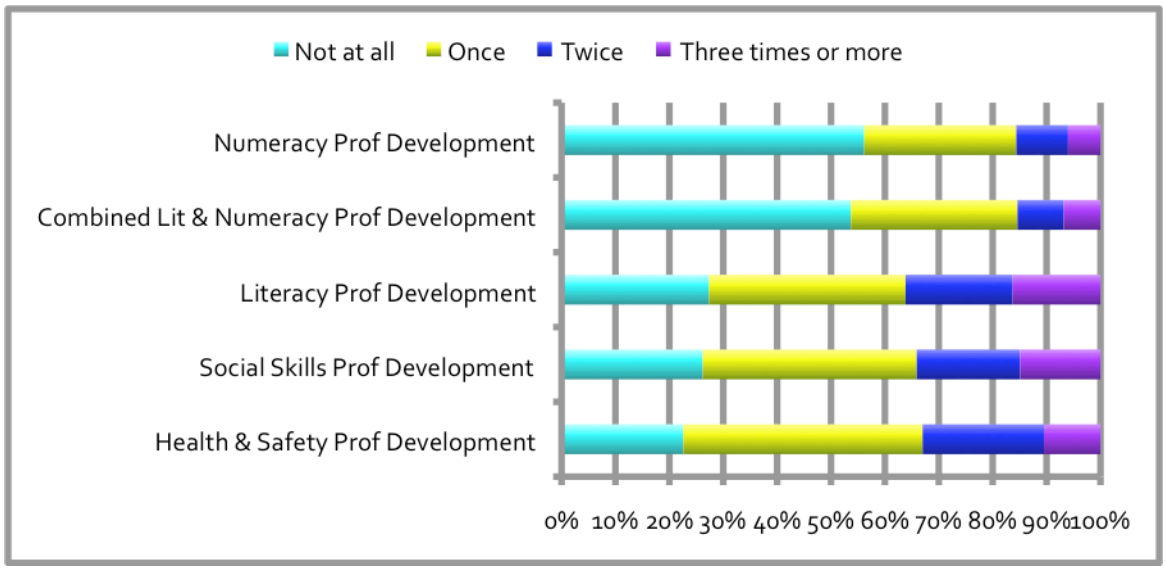
As expected, the vast majority of the respondents were women (98%). A third of the respondents (34%) reported administrative, instructor, consulting, or advisory positions. Another 36% reported working directly with children in a childcare centre. The rest of the sample reported working directly with children in home care or in other programs. The over-representation of administrators again reflects the recruitment strategy. Note, however, that administrators presumably used to work with children, and many continue to spend at least part of their day directly involved with children. Most who did not spend much of the day with children typically did not complete the questions about practices in the survey, and often added a explanatory comment to that effect. Furthermore, preliminary analyses suggested that administrators' responses were similar to those of respondents who worked directly with children most of the time. Thus, the analyses were not differentiated by employment roles.

Overall, the sample had quite high levels of education. Almost 60% of the respondents reported having an ECE college diploma, 12% have university degrees, and 29% have a college certificate or high school diploma. Ontario and Manitoba require that staff in child care centres have a minimum of a college diploma (Friendly et al., 2007), and the education levels in those provinces reflect this requirement– in both provinces, over 80% of the participants have an child care-related college diploma, undergraduate degree, or graduate degree. The high percentage of participation by administrators contributes directly to the overall high education level, as this group reported almost 50% of the university degrees in the sample.

Professional Development

Participants indicated how frequently they had attended different types of professional development (PD) over the last two years. Overall, most of the respondents had attended some kind of PD in the last two years, with close to 80% reporting attendance of social skills or health and safety PD at least once (as shown in Figure 2). Attendance of literacy PD was similarly high, with over 70% reporting attendance at least once in the last two years. Attendance of numeracy PD was lower, however, with only about 50% reporting any attendance in the last two years. These distributions for literacy and numeracy PD were significantly different, $\chi^2(9, N=642) = 384.63$, $p < .05$. Participants were twice as likely to have *never* attended numeracy PD, as compared to literacy PD (56% vs. 29% of respondents).

Figure 2. "How often did you attend professional development events over the last two years"?



Reports of attending PD also varied with employment roles. ELCC practitioners working directly with children were least likely to have attended early numeracy activities; 59% had not attended any such events in the last two years. Similarly, 52% of administrators had not attended any numeracy PD, while only 22% had not attended any literacy PD. Thus, across all

employment roles, participants' were least likely to have attended numeracy PD and most likely to have PD involving health and safety.

Each participant's frequency scores across the different types of professional development were summed to create an overall (total) professional development indicator. Administrators attended significantly more professional development activities than those working directly with children, with an mean total of 7.2, as compared to those who were working directly with children in nursery programs (6.6), child care centers (6.0), or home care (5.4), $F(3,766) = 6.89$, $p = .000$. Qualitative comments by the participants about the types of professional development they attended suggest that administrators are more likely to attend development oriented to their managerial and administrative roles. Comments also indicated that specific PD topics included working with children who have special needs (e.g., autism, Fetal Alcohol Spectrum Disorder, high risk), parenting, and the emergent curriculum.

Attendance of professional development activities may be constrained by whether respondents were aware of PD opportunities and whether they had the resources to attend. In Manitoba, for example, as explained to us by family childcare providers, PD relief is available for them as well as for staff in centres. To clarify the participants' responses about their frequency of attending professional development activities, we asked about the ELCC practitioners' awareness of professional development in their area. Participants reported being less aware of early numeracy than of early literacy professional development events, and the distribution of their responses were very different for literacy versus numeracy, $\chi^2(16, N=754) = 1407.5$, $p < .01$, as shown in Table 4. The majority of respondents agreed that they were aware of literacy PD (57%), with only 26% reporting that they were not. In contrast, for numeracy PD, 41% reported that they were aware of such opportunities and 39% reported that they were not.

Thus, access to early numeracy PD appeared to be less available to these respondents than access to literacy PD.

Table 4. Percentage of participants selecting each category: Awareness of professional development events about early literacy and early numeracy.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
I am aware of P.D. events about early numeracy	8	31	20	31	10
I am aware of P.D. events about early literacy	4	21	17	45	13

Summary

Overall, the respondents reported good access to professional development activities. Most had attended some professional development in the last two years. Individuals in administrative positions were more likely to have attended professional development activities than individuals working directly with children. However, respondents reported less awareness and less participation in PD for early numeracy than for early literacy, health and safety, or social skills. Thus, one barrier to awareness of early numeracy activities may be that little professional development is available in that domain.

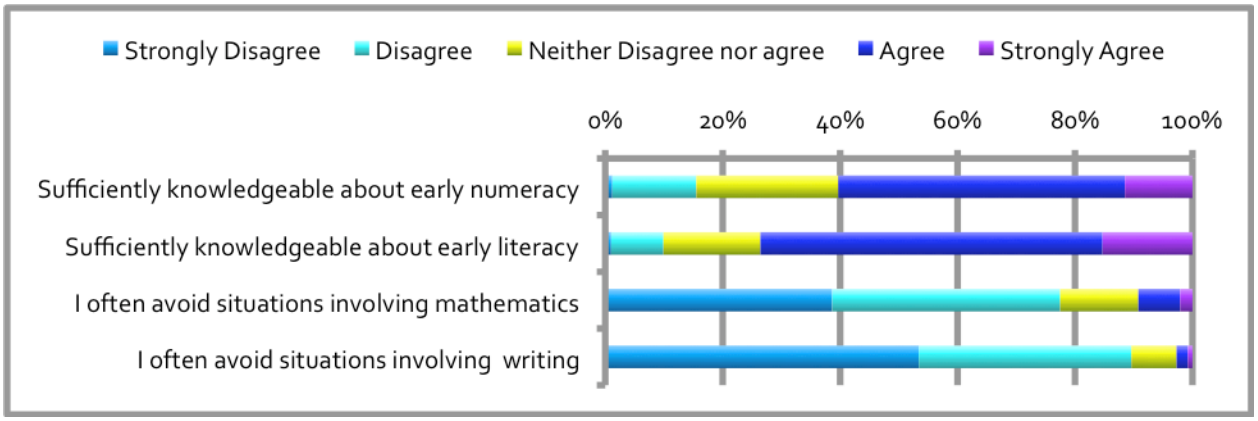
Knowledge

Three types of knowledge were assessed: Participants' self-reported knowledge of early literacy and numeracy, an assessment of their own attitudes towards mathematics and reading, and their knowledge about children's capabilities with respect to early literacy and numeracy.

Self-reported Knowledge of Early Numeracy and Literacy

To assess the ELCC practitioners' relative knowledge about early literacy and early numeracy, participants were asked to indicate to their agreement with the statements "I am sufficiently knowledgeable about early numeracy/early literacy." Figure 3 shows that their level of agreement with these statements was higher for literacy than for numeracy, although in both cases most participants agreed or strongly agreed with these statements (60% and 70% for numeracy and literacy, respectively), suggesting that they were comfortable with their level of knowledge in both domains. Taken in conjunction with the lack of early numeracy professional development, the somewhat lower levels of agreement with these statements for numeracy (vs. literacy) suggests that ELCC practitioners perceive a small, but persistent discrepancy between their knowledge of these two domains.

Figure 3. *Knowledge about early literacy and numeracy; Avoidance of math and writing.*



Self-reported Confidence in Mathematics and Writing Skills

Participants indicated that they are significantly more likely to avoid situations involving mathematics than situations involving writing, $t(750) = 11.18$, $p < .001$. This relative lack of confidence in math versus writing is not unique to ELCC practitioners. University students and

parents report similar discrepancies (LeFevre et al., 2003; in press), and individuals who reported avoidance of mathematics were more likely to have lower arithmetic fluency scores.

Knowledge of Children's Capabilities

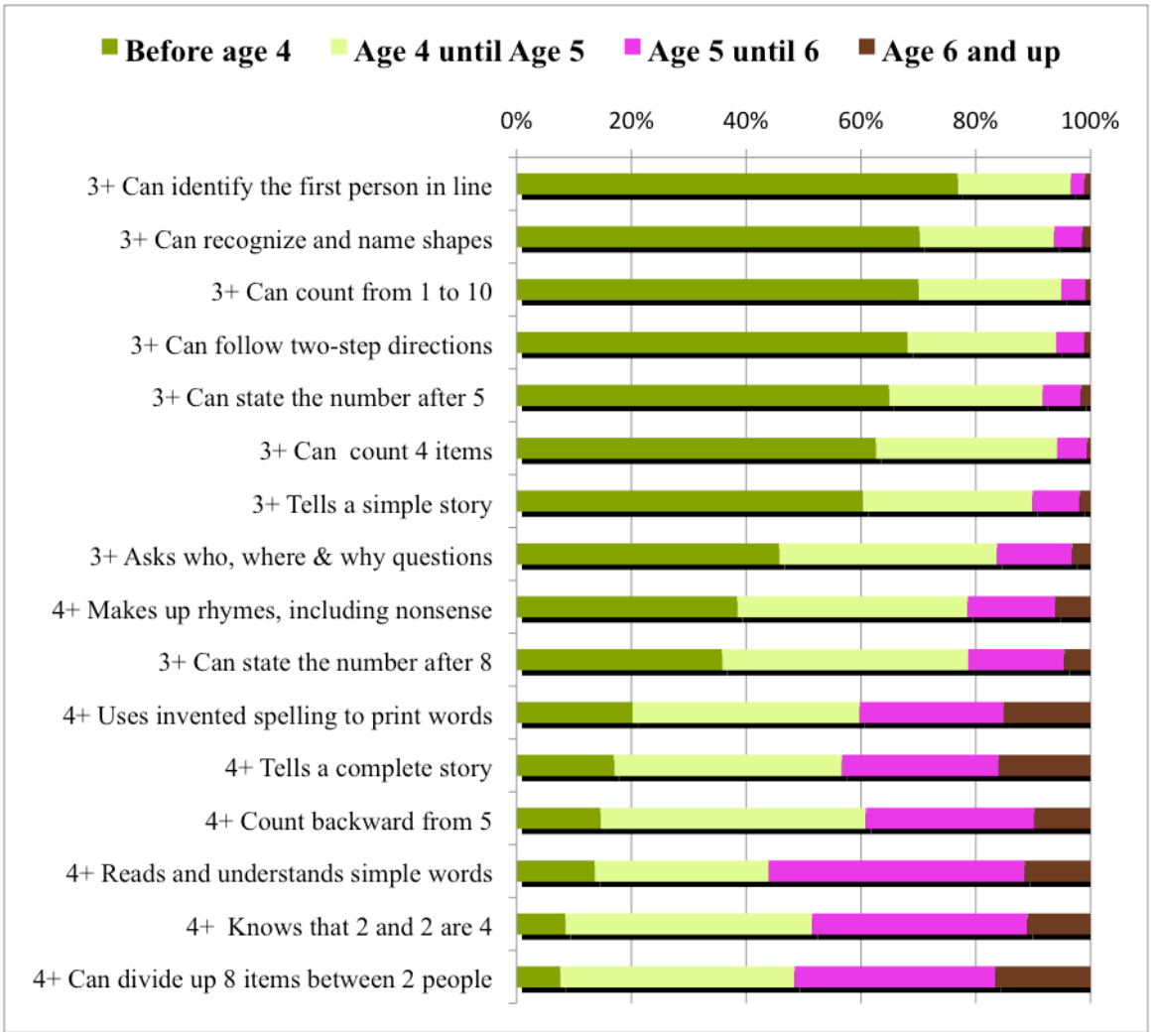
Application of developmentally appropriate practices requires accurate knowledge of typical development. The respondents indicated age groups at which children are capable of achieving sixteen literacy and numeracy activities. The items were selected to cover a range of ages, based on existing literature with typically developing children. Importantly, however, it is the relative, not the absolute ages that respondents chose that are of primary interest.

The percentage of respondents who chose each of the age ranges for the 16 items are shown in Figure 4. We were successful in choosing items that respondents could differentiate by age of capabilities. For example, almost 80% of respondents agreed that children can typically identify the first person in line before age 4, whereas very few indicated that children could read a few words before age 4. Overall, the responses provided by the ELCC practitioners were consistent with the age ranges suggested in the literature, especially for the basic milestones. Interestingly, however, as the achievements became more advanced (and thus more representative of early literacy and numeracy skill), respondents indicated that children were older when they were capable of the numeracy achievements as compared to similar literacy milestones. As shown in Figure 4, the indicated age distributions for reading a few words ('e.g., red or car'), addition ('Knows that 2 and 2 are 4') and division ('Knows how to fairly distribute 8 candies between 2 people') were very similar. About 50% of the respondents indicated that children were not capable of these activities until at least age 5. However, research has shown that children are capable of simple addition and division (with objects) earlier than the more

complex task of reading words. The respondents may be both overestimating children's literacy capabilities and underestimating their numeracy capabilities.

Parenthetically, the relatively large group of respondents indicating 'using invented spelling to print words' as achievable before age 4 suggests the possibility that these respondents are confusing the term 'invented spelling' with imaginary writing or scribbling. Our intent, and the definition used by educators is invented spelling as "non-conventional spelling of a word created by a novice reader or writer," with the implication that at least some of the letters are correct or phonemic (e.g., spelling CAT as KT).

Figure 4. *Percentage of respondents choosing each age range for the questions about children's capabilities. Item labels include the approximate target age ranges (3+: before age 4, 4+: age 4 and up) suggested by the literature.*

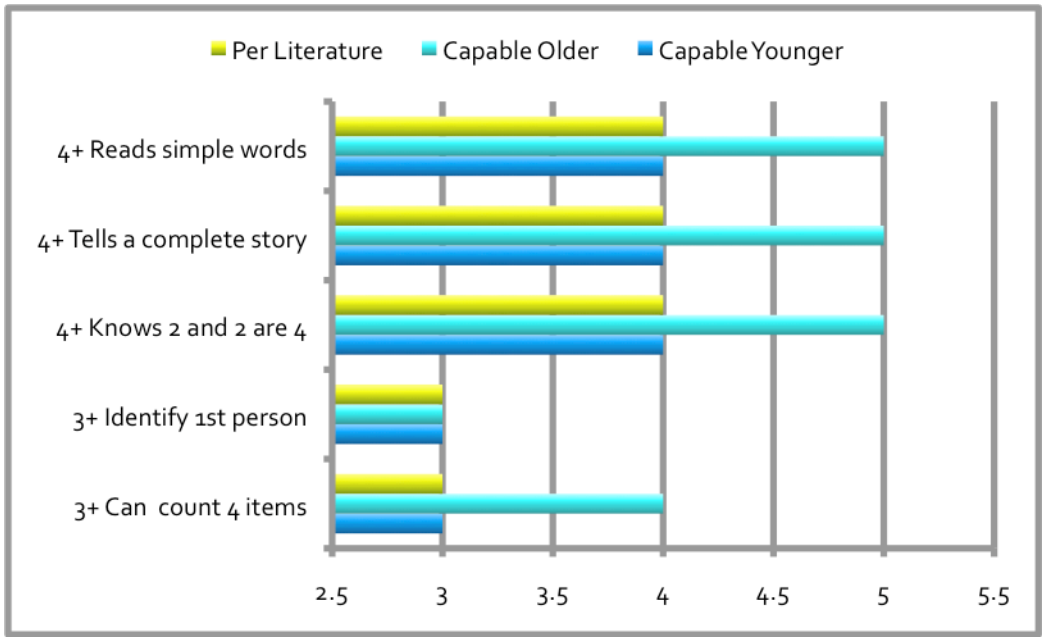


To identify patterns among the respondents' responses, we performed a cluster analysis of the complete set of achievement items. Respondents who had neglected to rate four or fewer of the items (74 respondents missed one item, 22 missed from two to four items) had the missing items replaced with the mean for that item. The analysis produced two distinct clusters of ELCC practitioners. One cluster of individuals (n = 329) tended to select relatively younger ages for all of the items. We called this group the "Capable Younger" cluster. The other group, in contrast, tended to select relatively older ages for most of the items and so we called them the "Capable

Older" cluster (n = 379). Subsequently, comparisons of mean ages across each items by group showed significant differences.

As shown in Figure 5, the Capable Younger cluster's median age for reading simple words and for simple addition was 4 years, in contrast to the median of 5 years for the Capable Older cluster. Overall, the median ages provided by the Capable Older cluster tend to reflect North American curriculum targets rather than the ages at which children have been shown to be capable of these activities in the research literature (Clements, 2004b; Millard & Waese, 2007)

Figure 5. *Comparison of some median ages by cluster with ages predicted by the literature.*



How does respondents' knowledge of children's capabilities relate to their other characteristics? To address this question, we compared knowledge cluster to the respondents' education level, frequency of attending literacy or numeracy professional development, type of work, avoidance of mathematics, and the dominant philosophy of the ELCC practitioner's program. None of these factors was related to knowledge cluster membership. However, years of experience in the field was related to knowledge cluster -- respondents with 10 or more years

experience were more likely to belong to the Capable Younger cluster than those with fewer than 10 years experience, χ^2 (1, N = 665) = 4.24, p = .039, suggesting that experience working with children influenced their assessment of children's capabilities – a reasonable result.

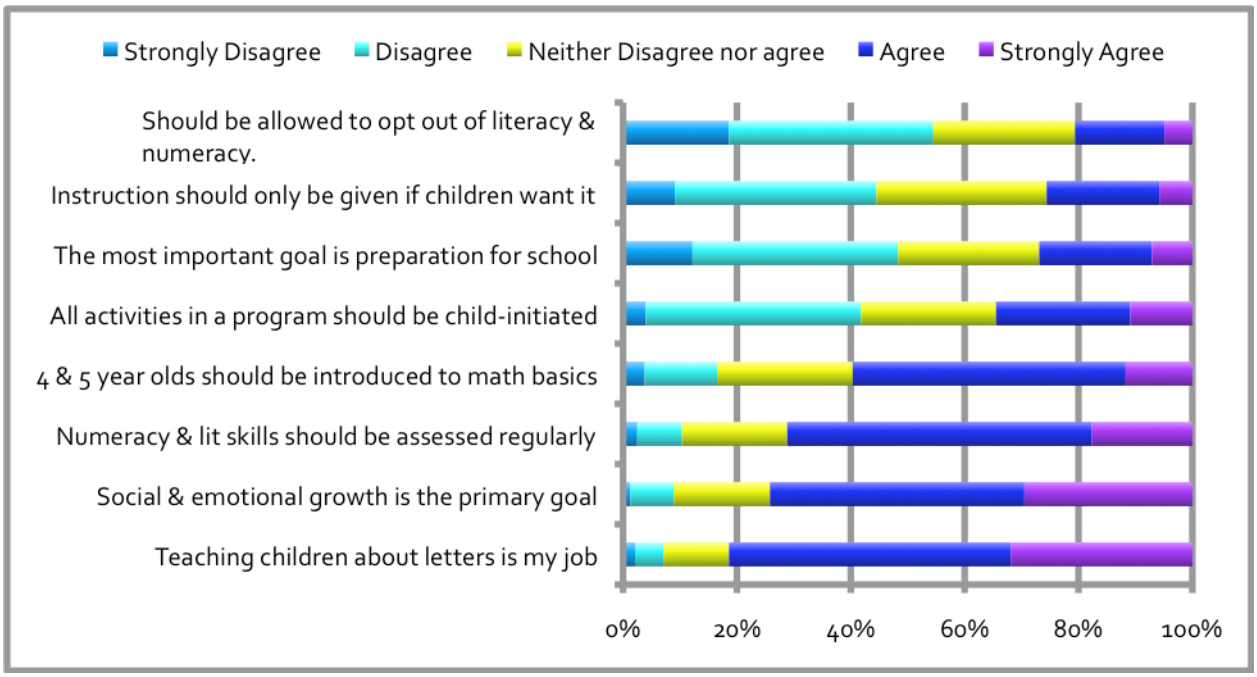
Summary

Survey respondents rated the ages at which children are capable of sixteen early literacy and early numeracy achievements. Cluster analysis showed that about half of the ELCC practitioners tended to view children as capable at younger ages than the other group. This realistic view may be attributed to experience – respondents in the Capable Younger cluster were significantly more likely to have been in the ELCC profession for ten or more years as compared to respondents in the Capable Older cluster.

Beliefs

Respondents were asked to indicate their degree of agreement with the list of beliefs. As expected, the majority of respondents (74%) agreed or strongly agreed that social and emotional development is the primary goal of early childhood education (Vartuli, 1999). However, the majority of respondents also agreed that it is their job to teach children about letters, and that numeracy and literacy skills should be assessed regularly. The majority *disagreed* with the view that children should be allowed to opt out of early literacy and numeracy activities, or that children should only be given formal instruction if they want it. As a group, therefore, our respondents appeared to believe that children's early numeracy and literacy development was important in the ELCC setting. These findings correspond to the perspective that we outlined in Part I – beliefs in developmentally appropriate practices and in child-centered activity can co-exist with the belief that children need to acquire early literacy and numeracy schools before they start Grade 1.

Figure 6. *Percentage of respondents choosing each agreement category for the various beliefs.*



The eight belief items in Figure 6 were related to early learning. These were analyzed in a cluster analysis.[3] Previous research (Stipek & Byler, 1997; Vartuli, 1999) cast ELCC practitioners into two different belief groups that were termed "child centered" and "basic-skills oriented." For continuity with this earlier work, we included four updated child-centered items and four basic skills items in our Beliefs question.

[3] Of the 768 participants, 720 completed all ten of the Belief items. Thirty-three participants had missed only 1 of the 10 items, another 13 had neglected to answer between 2 and 6 items. In order to maximize the number of participants in a cluster analysis, the belief items were recoded with missing items replaced with the mean of that item. Two further participants answered only one or two of the ten items – their responses were not included in the cluster analysis. A cluster analysis of the first eight belief items was performed for the remaining 766 participants.

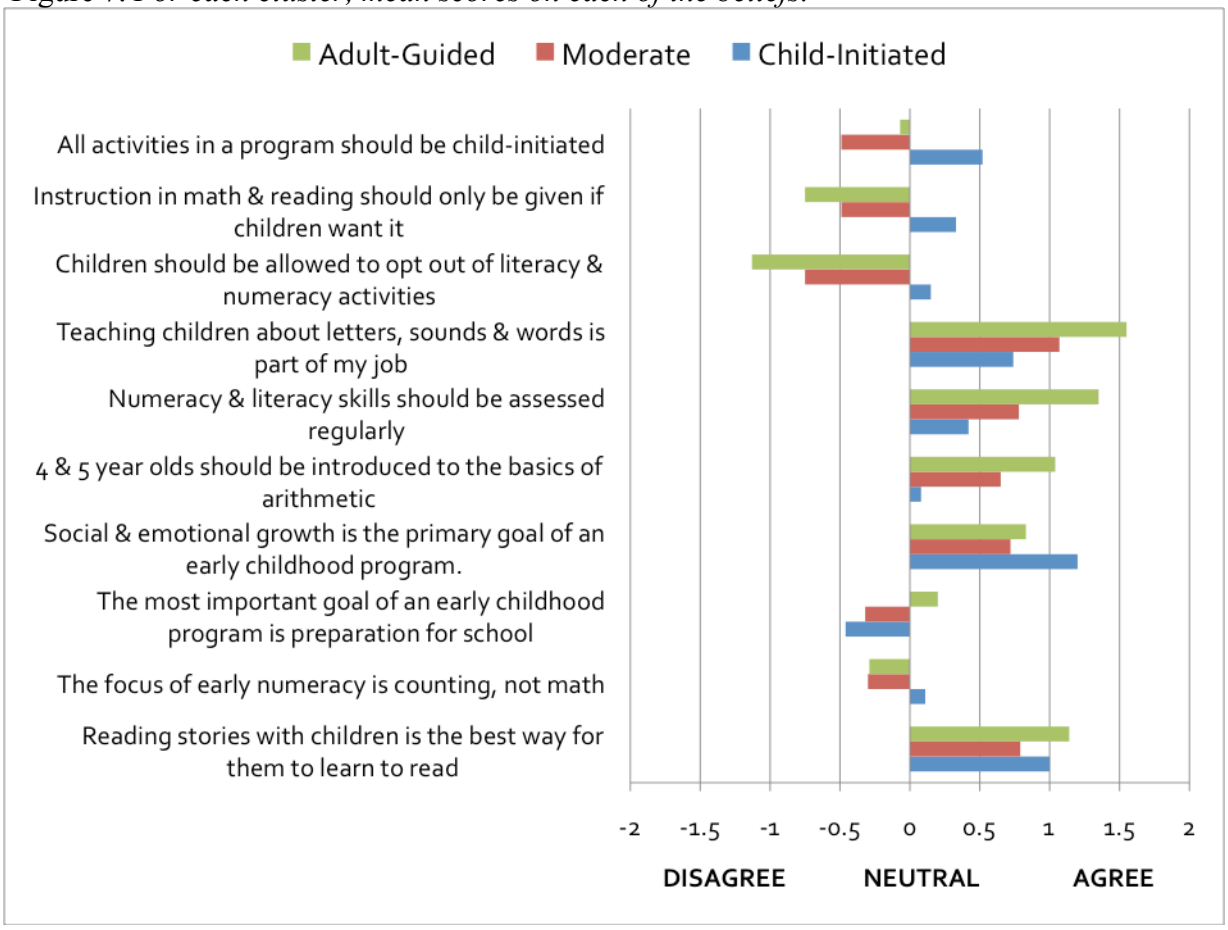
The cluster analysis produced three groups which we labeled "Moderate," "Child-Initiated," and "Adult Guided." These labels were selected to represent the patterns of agreement with the various belief statements. As we expected, our respondents did not cluster into strongly "child centred" versus "basic skills" groups. All three of the groups we identified agreed that "social and emotional development are the primary goals" of ELCC programs. Instead, the clusters we identified reflected the degree to which these respondents agreed with statements in which activities were more likely to be chosen or initiated by the child, hence, *Child Initiated* versus activities that were more likely to be chosen or initiated by the adult, hence, *Adult Guided*.

Almost half of the sample (n=297) appeared to hold moderate views about most of the listed beliefs. Another large group (n = 305) fell into a cluster defined by strong agreement with items in which children initiate the activities, as well as with most of the other child-centered statements. A smaller cluster of 164 respondents, about 20% of the sample, were more neutral or tended to disagreed with the Child-Initiated items and showed generally higher levels of agreement with an Adult-Guided approach to literacy and numeracy activities. Figure 7 shows the mean response to each item across individuals in each of the three clusters. For each of the belief statements, one-way ANOVAs indicated significant differences among the clusters, Fs(2,757) > 19, ps < .001. These differences were explored further using post-hoc analyses.

As expected, the post-hoc analyses show that the literacy and numeracy items were the most polarizing. In contrast to the Moderate and Adult-Guided clusters, individuals in the Child-Initiated cluster more strongly agreed that " Formal instruction in math and reading should only be given if children want it" and "Children should be allowed to opt out of literacy and numeracy activities." Both the Adult-Guided and Moderate clusters tended to disagree with these

statements, and with the statement that "All activities should be Child-Initiated." Thus, the defining characteristics of these clusters reflected individuals' views of the role of the ELCC practitioner in initiating and maintaining literacy and numeracy activities. Interestingly, all three groups tended to agree with the statement that "teaching children about letters, sounds and words is part of my job," with the strongest agreement in the Adult-Guided cluster.

Figure 7. *For each cluster, mean scores on each of the beliefs.*



Further comparisons of the responses across clusters showed interesting patterns on the goal-oriented items. The goal-oriented basic-skills belief is "The most important goal is preparation for school." The Adult-Guided cluster tended to agree with this statement whereas the Child-initiated and Moderate clusters tended to disagree. The child-centered statement "Social and emotional growth is the primary goal of an early childhood program" shows a

consistent inverse pattern, where the respondents in the Adult-Guided and Moderate clusters differ significantly not from each other, but from the strong agreement scores of the individuals in the Child-Initiated cluster.

Two items in the Beliefs question were not included in the original cluster analysis. These items were intended to capture beliefs about literacy and numeracy in early childhood, rather than about specific goals and philosophies. Nonetheless, there are significant differences among the belief clusters on these items. The Child-Initiated cluster tends to agree with the belief that "The focus of early numeracy is counting, not math," whereas the Moderate and Adult-Guided clusters tend to disagree, $F(2,757) = 13.39$, $p = .000$. Stipek and Byler's (1997) original Teacher Beliefs Scale categorized the item "Practicing letters and their sounds is the best way for children to learn to read" as a Basic Skills belief. We rephrased the item to capture a prevailing view about early literacy, that is, "reading stories is the best way to learn to read." All three of the clusters show strong agreement with the statement (cf. Evans & Shaw, 2008), albeit at different levels $F(2,757) = 7.56$, $p = .001$. However, post-hoc analyses (Bonferroni) shows that the Moderate cluster is significantly less likely to agree with this statement than the other clusters, $p < .05$.

Summary

In summary, analysis of the belief questions suggested that respondents vary in their beliefs about the role of early literacy and numeracy (i.e., early learning) activities in the ELCC setting. In contrast to older American studies, however, these beliefs were balanced – with most respondents responding fairly positively to the statements about early literacy and numeracy activities. Where the groups differed was in the extent to which they endorsed Child-Initiated as compared to Adult-Guided approaches to program implementation. These belief clusters

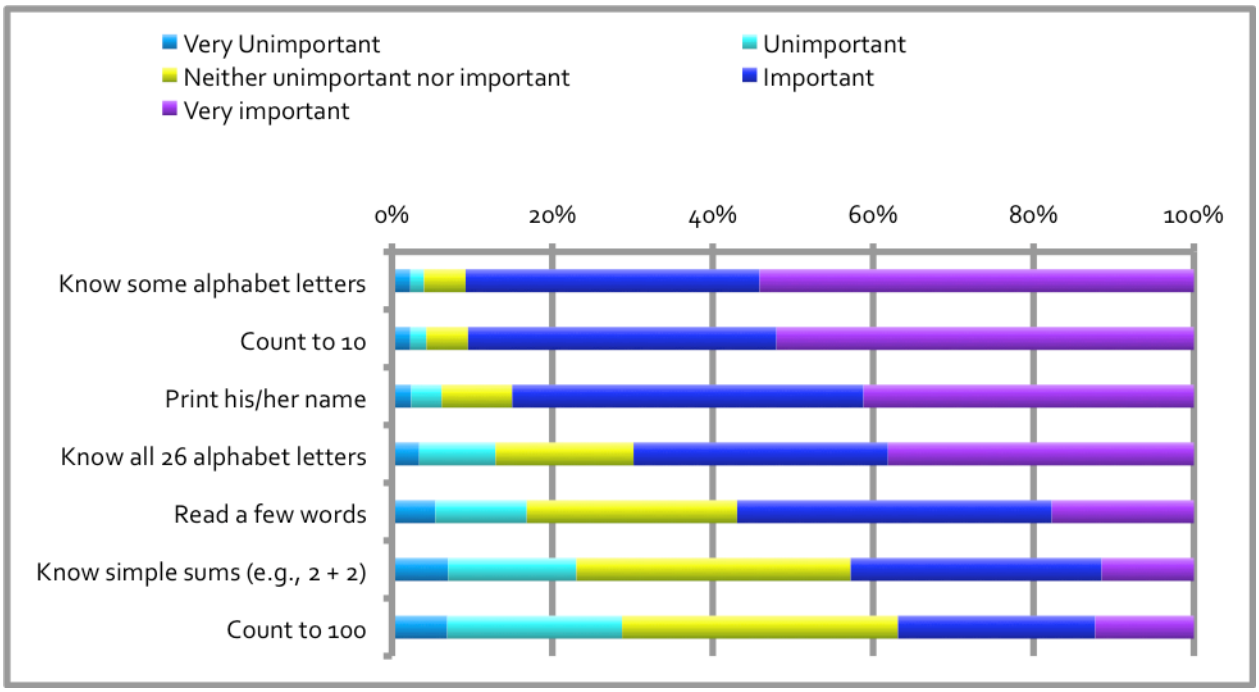
appeared to capture consistent trends among the respondents and were thus used in several subsequent analyses.

Beliefs about the Relative Importance of Early Numeracy and Literacy

An alternative way of assessing an individual's attitudes towards early numeracy and early literacy was also included in the survey. Respondents were asked to indicate how important it was for children to achieve certain academic benchmarks BEFORE Grade 1. This question has been used in several studies with parents (LeFevre et al., 2002; in press). Consistent with the ELCC practitioners' endorsement of the belief that early numeracy is primarily about counting, 'counting to 10' was rated similarly to 'knowing some alphabet letters.' Although most Kindergarten curricula specify that children should "investigate addition and subtraction in everyday activities through the use of manipulatives" (Ontario Kindergarten curriculum, 2006), only about 40% of the ELCC practitioners in this sample agree that that 'knowing simple sums' is an important benchmark before Grade 1. Importance ratings for knowing simple sums were significantly lower than reading a few words (.25 vs. .53), $t(752) = -9.88$, $p = .0000$, just as 'counting to 100' was rated significantly less important than knowing all 26 letters of the alphabet (.14 vs. .91), $t(750) = -22.29$, $p = .000$.[4]

[4] For these comparisons, the responses to each question were coded as -2=very unimportant, 2=unimportant, 0 =neither, +1=important, and +2=very important. So larger values indicate that the benchmark was rated as more important.

Figure 8. *Percentage of respondents indicating the importance of children achieving each of these academic benchmarks before starting Grade 1.*

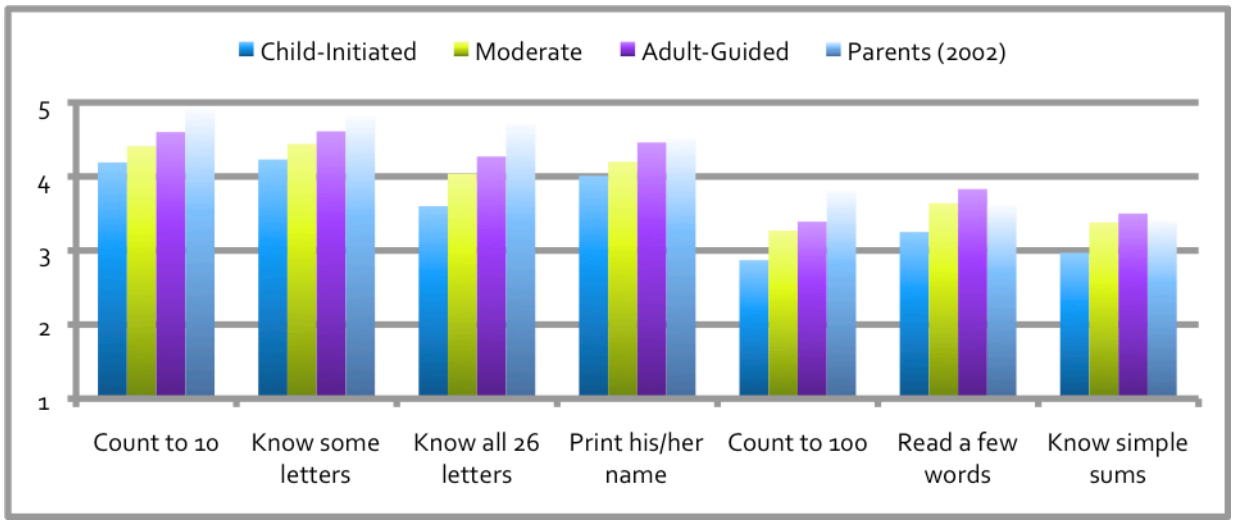


Further analyses of the importance accorded to the literacy and numeracy benchmarks were conducted with the cluster scores for the beliefs described in the previous section. The mean importance, averaged across individuals in the three belief clusters (i.e., Child-initiated, Adult-Guided, and Moderate) are shown in Figure 9 with data from parents of young children (LeFevre et al., 2002). Parents indicated that most of the skills were very important for children to achieve, in most cases rating skills higher than did the ELCC practitioners. However, parents and practitioners similarly ranked the more complex abilities (read a few words, count to 100) as relatively less important than the simpler or more basic skills (know a few letters, count to 10). So the patterns were similar between parents and practitioners.

The importance ratings were analyzed in a 3 (Belief clusters: Child Initiated, Moderate, Adult Guided) x 7(Skills) ANOVA showed significant differences in importance ratings across the clusters, $Fs(2,752) > 12.0$, $ps < .01$. Post-hoc analyses (Bonferroni) revealed that mean

importance indicated by individuals in the Child-Initiated cluster was significantly lower than the other clusters for all of the items, *p*s < .05. Thus, respondents who believed that children should self-initiate early literacy and numeracy activities also consider academic preparation to be less important for children before starting school.

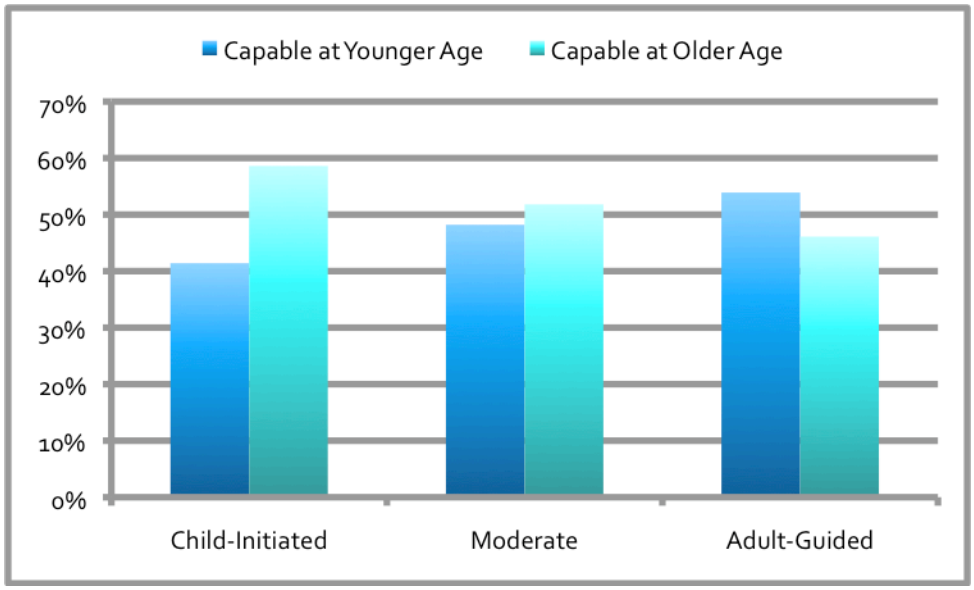
Figure 9. *Mean importance ratings for pre-Grade 1 benchmarks by belief clusters and by parents of English-speaking preschoolers (n = 27) in LeFevre, Clarke, and Stringer (2002). In the five-point scale, 5 is very important and 1 is very unimportant.*



Beliefs and Knowledge of Children's Capabilities

As shown in Figure 10, respondents' beliefs were related to their knowledge of children's capabilities. Individuals in the Adult-Guided cluster were more likely to indicate that children were capable of the both literacy and numeracy skills at a relatively younger age, whereas individuals in the Child-Initiated belief cluster were more likely to indicate that children were capable at an older age (and thus tended to underestimate children's abilities), $\chi^2(2, N = 701) = 6.53$, $p = .038$.

Figure 10. *Percentage of individuals in each of the three belief clusters who were categorized into each of the academic achievement clusters.*



Beliefs and Perceived Knowledge of Early Numeracy and Early Literacy

As shown in Table 5, respondents clustered by belief also differed significantly in their agreement that they have sufficient knowledge of early numeracy, $\chi^2(8, N = 762) = 60.70$, $p = .000$. The members of the Adult-guided cluster appear to be more confident of their knowledge

of early numeracy. As seen in Table 5, 69% agreed or strongly agreed that their knowledge is sufficient, compared with only 54% of the individuals in the Child-Initiated cluster.

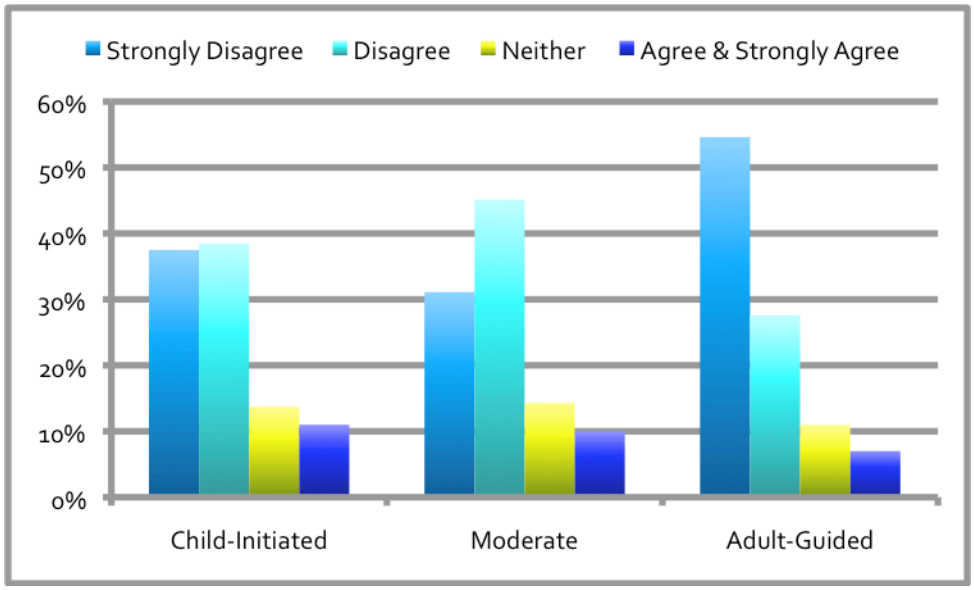
Table 5. *Percentage of respondents in each belief cluster indicating agreement with the statement "I have sufficient knowledge of early numeracy".*

	Belief Clusters		
Rating	**Child-initiated**	**Moderate**	**Adult-Guided**
Strongly Disagree	**0**	2	2
Disagree	14	16	13
Neither Disagree nor agree	33	20	15
Agree	44	56	45
Strongly Agree	10	6	24
	100	100	100

Beliefs and Avoidance of Mathematics

Members of the Adult-Guided cluster not only indicated more confidence in their knowledge of early numeracy, they were also significantly less likely to avoid situations involving mathematics. A chi-square analysis of the three belief clusters by their responses to the mathematics avoidance item showed a significant difference in the clusters' responses to the mathematics item, χ^2 (8, N = 755) = 26.17, p = .001. As shown in Figure 11, more of the individuals in the Adult-Guided cluster strongly disagreed with this statement (55%) than those in the other two clusters, 38% and 31% for the Child-initiated and Moderate clusters, respectively. For the avoidance of writing question, the three belief clusters did not differ significantly in the extent to which they disagreed with this statement, χ^2 (8, N = 754) = 14.10, p = .079.

Figure 11. *Ratings for "I often avoid situations involving mathematics" by Belief Cluster*



Summary of Results for Belief Clusters

In contrast to studies done the early 1990s, the respondents in the current work did not cluster into polarized groups who favored "child centred" versus "basic skills" approaches to early childhood education. Instead, we identified clusters of ELCC practitioners who varied in the extent to which they endorsed beliefs favoring more child-initiated versus adult-guided approaches to early learning. The majority of our participants saw a role for teaching about letters and numbers in early childcare settings. Differences appeared in when and how that teaching should occur.

Individuals in the Child-initiated cluster tended to think that children are not capable of certain early numeracy and literacy achievements until up to a year later than indicated by the literature. In contrast, individuals in the Adult-Guided cluster tended to agree with the age milestones reported in the literature. Similarly, individuals in the Child-initiated cluster tended to rate reaching certain numeracy and literacy benchmarks before Grade 1 as less important than did individuals in the Moderate and Adult-Guided clusters. Finally, individuals in the Child-

initiated cluster (representing over a third of the respondents) were also less confident about their knowledge of early numeracy and their own mathematical skills. These results suggest that beliefs and knowledge are closely related among the individuals in this sample. This is an interesting and relevant pattern of results that can inform education and professional development.

Practices

The preceding analysis concerning ELCC practitioners' knowledge and beliefs are relevant in interpreting their responses to the questions about practices. Here, we first describe the overall patterns and findings for practices and then relate those results back to the knowledge and beliefs. In the survey, respondents were asked to indicate how frequently they engaged in a variety of practices, but these were specific to the age group of the children with whom they spent most of their time. One set of literacy, numeracy, and emotion-related activities was presented to those who selected Infants (under 12 months) or Toddlers (1 and 2 year olds). A different set of activities, also covering literacy, numeracy, and emotion, was presented to respondents who selected Preschoolers (3 and 4 year olds), School-age children (5 and 6 year olds), or After-School (6 plus). Table 6 shows the number of respondents in each category. Some respondents, perhaps intimidated or bored with the extensive list of practices, simply clicked 'Most Days' for every item – these individuals were not included in the analyses. Also, because very few respondents indicated that they only cared for infants (n = 32), they were also not included in analyses.

Table 6. *The number of individuals who selected each age group for the practices questions; showing how many had invalid responses either because they selected "Most days last week" for all items, or did not indicate frequencies for any of the items. These individuals were not included in further analyses.*

	Number of Individuals			
Age Groups	**Selected Age Group**	**Selected 'Most days' for all items**	**Were Missing all Practices Data**	**Total Valid**
Preschoolers	444	7	9	428
Toddlers	164	7	1	156
School-Age	69	11	3	55
After School	43	2	2	39
Infants	34	1	1	32

Toddlers

Figure 12 shows the percentage of individuals who worked with toddlers who selected each of the frequency categories for each activity. Some of the selected activities were performed on a daily or almost daily basis, such as reading storybooks, conversations and turn-taking, asking questions during reading, singing songs, and playing finger games with numbers. The more advanced activities showed much greater variability, with sorting and classifying and pointing out words, letters, or sounds rated as relatively less frequent for many individuals. Note that the numeracy activities listed for this age group were oriented to counting – singing songs, counting fingers and toes during daily life, or reading number stories. None of these was rejected by a majority of the respondents, suggesting that we had selected generally appropriate activities.

Figure 12. *Percentage of respondents selecting each frequency for the various practices. Data are for 156 respondents caring for Toddlers (1 and 2 year olds).*

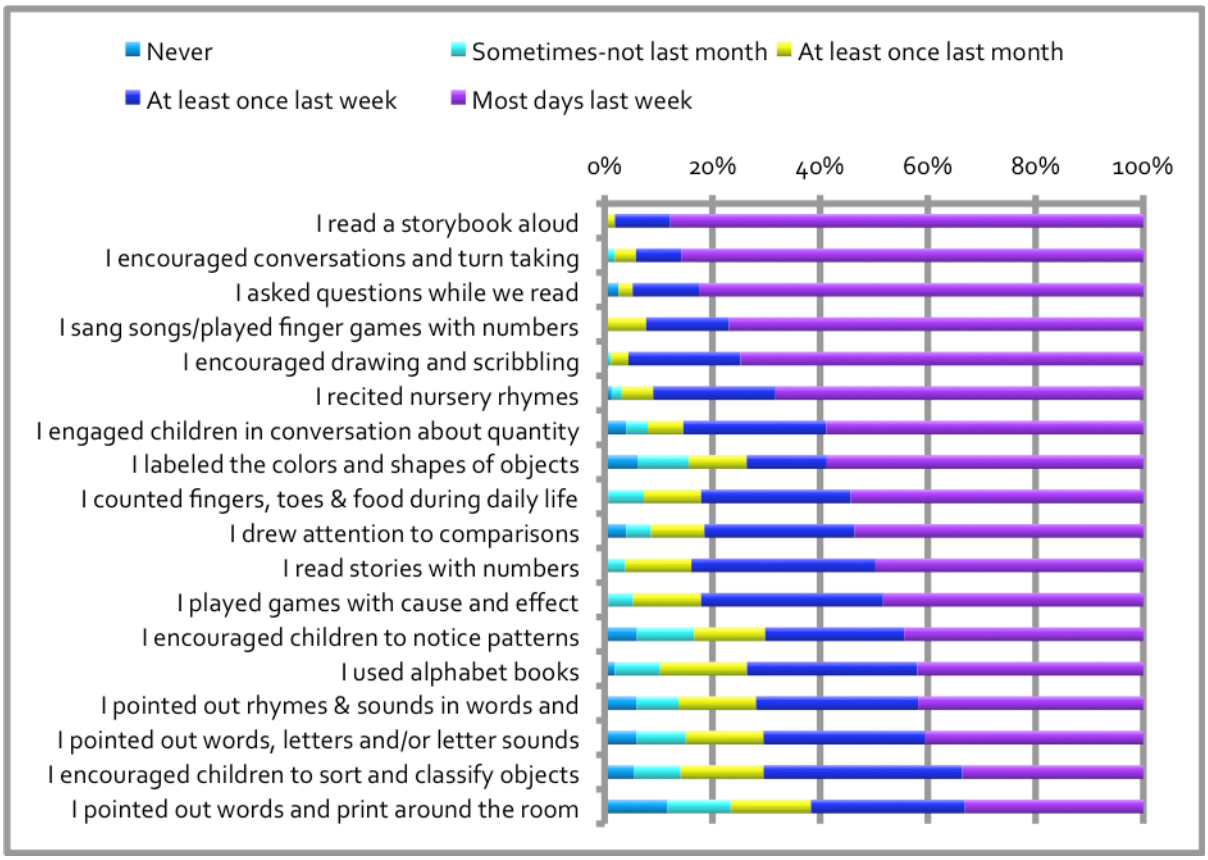
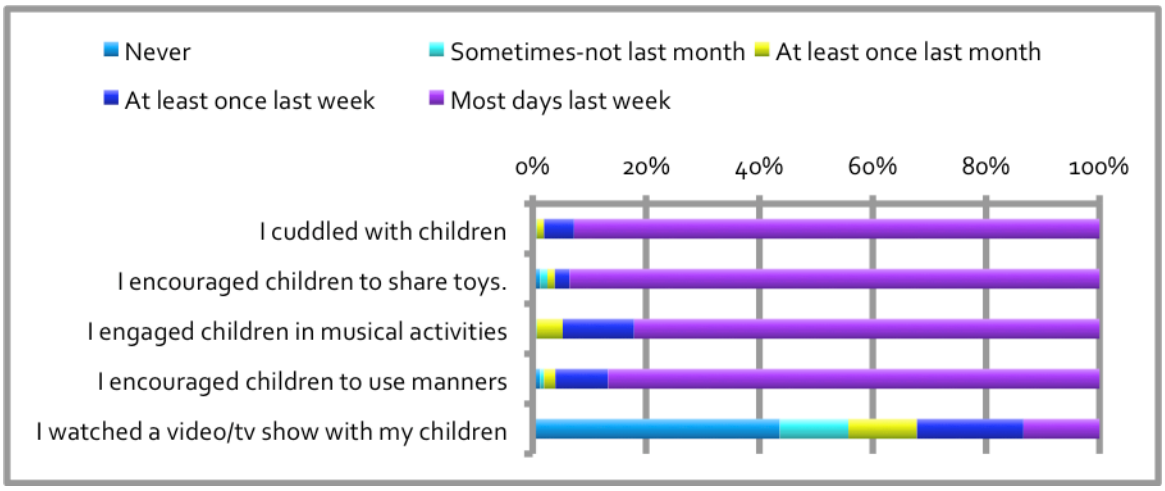


Figure 13 shows the choices of an additional five items that were included in this question for toddlers. These activities were oriented to social and emotional development and were included both as controls and to provide balance to the set of 25 activities. Other than 'watching a tv/video show,' over 90% of the respondents rated these activities as performed almost daily. Thus, it appears that respondents were responding as expected to this question.

Figure 13. *Percentage of respondents selecting each frequency for the various practices. Five Additional Choices Included for Toddlers.*



The practices included a balance of literacy and numeracy activities, and within each domain, the activities ranged from basic activities that might possibly occur daily to more advanced activities that might be less frequent. To simplify and reduce the data, we used factor analysis separately on the literacy and numeracy practices (principal components with varimax rotation). Two items were not included in the analysis: for the frequency of manipulative play, all respondents selected 'most days,' suggesting that the intent was misunderstood, and the Baby Sign Language item was omitted because it had extremely low frequency.

Literacy practices. The factor analysis accounted for 63% of the common variance among the activities and resulted in three factors. We labeled them Language, Pre-reading, and Talking. Note that the item "I recited nursery rhymes" did not load above .5 on any of the factors, suggesting it was not closely related to the other activities. The language factor included storybook reading, asking questions while reading, drawing and scribbling, and using alphabet books, but the latter was not as strongly related to the factor as the other items. As shown in Table 7 below, the items loading on the pre-reading factor included items that related to typical early literacy activities, such as pointing out words and print.

Table 7. *Literacy Factor Loadings*

ROTATED LITERACY FACTORS	Language	Pre-reading	Talking
I read a storybook aloud	**0.85**	0.08	0.19
I encouraged drawing and scribbling	**0.81**	0.26	-0.06
I asked questions while we read	**0.61**	0.08	0.49
I used alphabet books	**0.56**	0.31	0.08
I pointed out some words, letters and/or letter sounds	0.19	**0.81**	0.08
I pointed out words and print around the room	0.19	**0.79**	0.02
I pointed out rhymes and sounds in words and songs	0.12	**0.77**	0.17
I encouraged pretend or real conversations and turn taking	-0.04	0.08	**0.90**
I recited nursery rhymes	0.32	0.13	**0.49**

Numeracy practices. For the numeracy activities, the factor analysis also resulted in three factors and accounted for 61% of the variance. However, only the first factor was readily interpreted. It was labeled as "Quantities and Patterns," as these are the types of activities contributing most heavily to that factor. The second and third factors are less clear, as activities contribute fairly equally across them. Overall, for toddlers, the numeracy practices did not seem to form "good" (that is interpretable) factors. This result probably indicates that practitioners who work with Toddlers do not discriminate among the various numeracy-related activities.

Table 8. *Numeracy Factor Loadings*

ROTATED NUMERACY FACTORS	Quantity and Patterns	2	3
I encouraged children to notice patterns	**0.69**	-0.30	0.05
I drew attention to comparisons	**0.69**	0.01	-0.46
I encouraged children to sort and classify objects	**0.67**	-0.38	0.02
I counted fingers and toes and food during daily life activities	**0.65**	0.42	-0.01
I engaged children in conversation about quantity	**0.61**	-0.58	0.11
I labeled the colors and shapes of objects	**0.56**	0.11	-0.48
I played games with cause and effect	0.54	**0.51**	-0.16
I read stories with numbers	0.53	0.12	0.49
I sang songs/played finger games with numbers	0.49	0.28	**0.61**

Comparisons between Frequencies of Numeracy and Literacy Activities. To compare the frequency of the sets of activities, a mean score for the group of items in each factor was computed by averaging the ratings across the items for each participant. If a respondent chose not to select a frequency rating for an activity, the mean for the factor containing that activity was not computed. As shown in Table 9 below, Pre-reading activities such as pointing out words, print, and letter sounds were reported significantly less often than the activities in the other factor groups (e.g., Pre-Reading versus Quantity and Patterns, $t(150) = -4.68$, $p = .000$). Activities in the Quantity and Patterns factor were also performed significantly less frequently than those in each of the Language and Talking factors. Thus, practitioners who worked with Toddlers reported a higher frequency of activities related to language learning than early numeracy (or pre-numeracy) and pre-literacy activities.

Table 9. *Mean frequency scores for activities in Literacy and Numeracy factor groups.*

FACTOR	N	Mean	Std. Deviation
Language	156	3.6	0.5
Talking	155	3.6	0.5
Quantity and Patterns	151	3.1	0.7
Pre-reading	155	2.8	1.0

Relations between Activities and Beliefs and Knowledge. The factor means were analyzed in a 4(practice factors: Language, Talking, Quantity and Patterns, Pre-Reading) x 3(belief cluster: Adult-Guided, Moderate, Child-Centered) mixed analysis of variance. There were no differences in the frequencies of practices across belief clusters, but notably, only 23 members of the Adult-Guided cluster worked with children in the Toddler age group.

Next, the factor means were analyzed in a 4(practice factors) x 2(Knowledge: Capable Younger, Capable Older) mixed analysis of variance. As shown in Table 10, the individuals in the Capable Younger cluster reported higher frequencies of the pre-reading and the quantities and patterns activities than did the individuals in the Capable Older cluster. Thus, the beliefs of the ELCC practitioners in the toddler sample (that children are capable of early numeracy and literacy at an early age) are consistent with their practices.

Table 10. *Means and ANOVA results of Toddler Factor Scores with Capability Clusters*

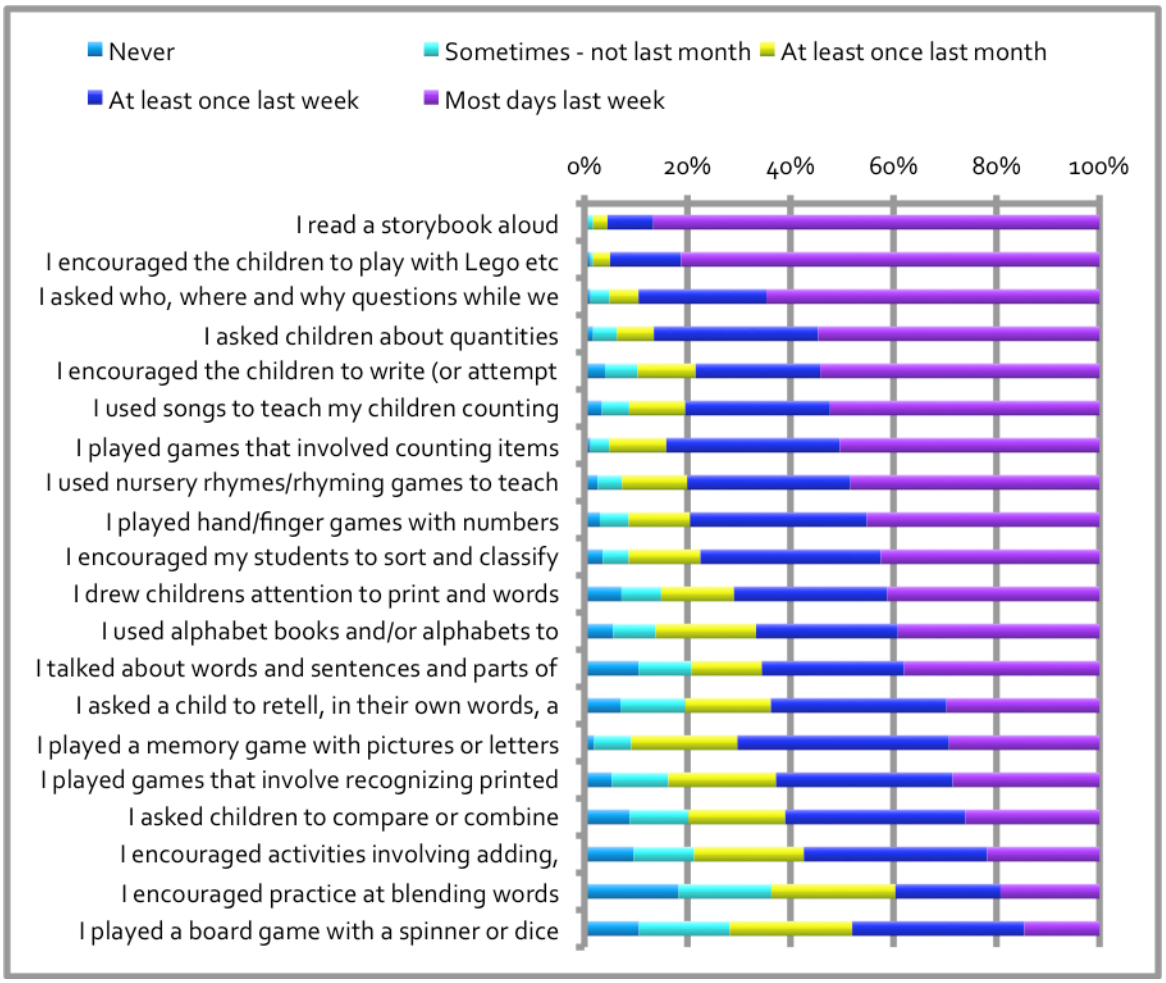
	Capable Younger			Capable Older			Comparison	
FACTOR	***N***	***Mean***	***SD***	***N***	***Mean***	***SD***	***F***	***p***
Language	67	3.7	0.4	78	3.5	0.6	2.90	0.09
Talking	67	3.7	0.5	78	3.6	0.6	1.22	0.27
Pre-Reading	67	3.2	0.7	78	2.5	1.2	16.79	0.00**
Quantity and Patterns	67	3.4	0.6	76	2.9	0.8	14.22	0.00**

Summary. ELCC respondents (n = 156) indicated how frequently they participated in 25 activities with the toddlers in their care. Exploratory factor analysis produced three literacy factors: we labeled them as Language, Pre-reading, and Talking. For the numeracy activities, the single clearly interpretable factor was labeled as Quantities and Patterns. Activities in the Pre-reading factor were performed the least frequently, followed by Quantities and Patterns. ELCC practitioners who believed that children are capable of various literacy and numeracy skills at younger ages put those beliefs into practice by reporting more of the pre-Reading and Quantities activities with the children in their care.

Preschoolers

A majority of the respondents in the study selected the preschool group (3 and 4 year olds) as the age group with whom they worked with most frequently. These 428 individuals, like those who worked with toddlers, chose storybook reading as the most frequent activity, as shown in Figure 14. In contrast, arithmetic and pre-reading letter and phonological skill activities were reported the least often. Of the numeracy activities, counting songs and games, and attention to quantities were frequently reported, whereas playing board games was less frequent. The latter activities may be more difficult in centre settings, where there are relatively large groups, and in home care if there are children of a range of ages.

Figure 14. *Frequency ratings by respondents caring for preschoolers (1 and 2 year olds) for Literacy and Numeracy activities, ordered by percentage of responses for 'Most days last week'.*



Literacy and Numeracy Factors. As with the Toddler practices, separate Factor Analyses (principal components, varimax rotation) were performed on the set of literacy activities and on the set of numeracy activities. In each analysis, two factors emerged, accounting for 52% and 54% of the variance, respectively for literacy and numeracy. Based on the loading of the items in the factors, as shown in Table 11 below, the literacy factors were labeled as Language and Pre-reading. The numeracy factors were labeled Quantities and Arithmetic and Counting and Lego.

Table 11. *Factor Loadings for Literacy and Numeracy Activities for Preschoolers (N = 428)*

Preschool Literacy Factors	Language	Pre-reading
I read a storybook aloud	**0.82**	-0.03
I asked who, where and why questions while we read	**0.71**	0.32
I used nursery rhymes/rhyming games to teach about sounds	**0.64**	0.31
I played a memory game with pictures or letters	**0.61**	0.27
I encouraged the children to write (or attempt to write) their name	**0.56**	0.33
I used alphabet books and/or alphabets to teach letters	**0.50**	0.30
I encouraged practice at blending words	0.17	**0.79**
I talked about words and sentences and parts of a story while I read	0.14	**0.76**
I asked a child to retell, in their own words, a story	0.42	**0.62**
I drew attention to print and words and their meaning	0.29	**0.55**

Preschool Numeracy Factors	Quantities and Arithmetic	Counting and Lego
I asked children to compare or combine quantities	**0.80**	0.19
I encouraged activities involving adding, subtracting or measuring	**0.80**	0.14
I asked children about quantities	**0.60**	0.34
I played games that involve recognizing printed numbers	**0.55**	0.41
I played a board game with a spinner or dice	**0.54**	0.16
I encouraged my students to sort and classify objects	0.49	0.49
I played games that involved counting items	0.40	**0.67**
I played hand/finger games with numbers	0.30	**0.62**
I used songs to teach my children counting words	0.26	**0.73**
I encouraged the children to play with Lego etc	0.04	**0.80**

Comparisons between the Frequencies of Literacy and Numeracy Activities. For each respondent, mean scores for the items associated with each of the four factors were computed. Similar to the Toddler data, these results show the Quantities activities were performed less frequently than Counting activities, $t(428) = -21.16$, $p = .000$. Correspondingly, the Pre-Reading activities were performed less frequently than the Language activities, $t(428) = -18.11$, $p = .000$. However, there were no differences in reported frequencies between the two more basic factors (Language vs. Counting) or between the early academic activities factors (Quantities vs. Pre-

Reading). Thus, the early literacy and numeracy practices were overall less frequent than more fundamental early learning activities.

Table 12. *Mean Scores for items in each factor for respondents caring for Preschoolers.*

Preschool Factors	N	Mean	Std. Deviation
Language	428	3.2	0.7
Counting	429	3.4	0.7
Quantities	429	2.7	0.8
Reading	429	2.6	1.0

Relations between Knowledge and Practices. If an individual's knowledge indicated that children were not capable of certain activities, we might expect that she would not use those activities with the children in her care. To test this possibility, mean frequencies were analyzed in a 2 (knowledge group: Capable Younger, Capable Older) x 4 (practice factors: Language, Counting, Quantities, Reading) mixed analysis of variance. As shown in Table 13, frequencies varied with knowledge cluster, $F(1, 382) = 4.46$, $p = .006$. Respondents who believe children are capable of various early learning activities at a younger age reported significantly higher frequencies for the activities in every factor.

Table 13. *Comparison across Knowledge clusters for mean scores reported frequency of literacy and numeracy activities.*

	Capable Younger			Capable Older			Comparison	
ACTIVITY FACTOR	***N***	***Mean***	***SD***	***N***	***Mean***	***SD***	***F***	***p***
Language	196	3.4	0.6	194	3.2	0.6	9.31	.00**
Counting and Lego	196	3.5	0.6	195	3.3	0.6	5.46	.02*
Pre-Reading	196	2.8	0.9	195	2.4	0.9	13.70	.00**
Quantities and Patterns	196	2.9	0.7	195	2.5	0.8	19.05	.00**

Relations between Beliefs and Practices. The relations between frequencies of reported practices and beliefs were analyzed in a (3 belief groups: Adult-guided, Moderate, Child-Initiated) x 4 (practice factors: Language, Counting, Pre-Reading, Quantities) mixed analysis of variance. As shown in Table 14, each of the mean scores shows a significant difference across the belief clusters (*F* statistics are listed in Table 14). Post-hoc analyses show that for all of the factors, the reported frequencies are higher for the Adult-Guided group than for the other two groups, which do not differ significantly. Thus, individuals in the Adult-Guided cluster also are more likely to reported academically-related activities with the children in their care.

Table 14. *Mean frequencies of each type of preschool activities for the individuals in each of the three belief clusters (Child-Initiated, Moderate, and Adult-Guided).*

Preschool Activities	Belief Cluster	N	Mean	SD	F	Sig.
Language	Child-Initiated	172	3.2	0.7	8.60	.00**
	Moderate	161	3.2	0.6		
	Adult-Guided	94	3.5	0.6		
Pre-reading	Child-Initiated	172	2.5	0.9	5.80	.00**
	Moderate	162	2.5	1.0		
	Adult-Guided	94	2.9	1.0		
Quantities	Child-Initiated	172	2.5	0.8	7.47	.00**
	Moderate	162	2.6	0.8		
	Adult-Guided	94	2.9	0.8		
Counting	Child-Initiated	172	3.3	0.7	6.05	.00**
	Moderate	162	3.3	0.7		
	Adult-Guided	94	3.6	0.6		

Relations between Practices and Avoidance of Mathematics and Writing. Previous studies have shown that adults who are more likely to avoid mathematics are also less skilled at arithmetic (LeFevre et al., 2003). For parents, lower confidence in their math abilities is related to a lower frequency of reported numeracy practices (LeFevre et al., in press). To assess whether similar patterns are present in this sample of ELCC practitioners, we calculated the correlations

between the frequency of the numeracy practices (i.e., the Quantities and Counting factor scores) and the extent to which participants avoided math. As expected, there was a significant relation – participants who were more likely to avoid math also reported less frequent numeracy activities, *r*s(419) = -.18, *p*s < .001. These correlations were quite small, but remained significant after controlling for participants' avoidance of writing (that is, their more general propensity to avoid academic activities), *pr*(413) = -.14, *p*s < .05. Thus, there was a consistent relation between their own feelings towards mathematics and the extent to which they reported early numeracy practices. In contrast, the relations between avoidance and writing and early literacy practices were not significant.

Relations between Practices and the Socio-Economic Status of Children in Respondents' Programs. In contrast to previous studies showing a relation between SES of the children and practices of the ELCC practitioners, analysis of the preschool practice means for each factor by the percent of subsidized children in the program and the percent of impoverished children in the program do not show significant differences in frequency of practices. There are a number of possible explanations for these results, but the primary factor may simply be that the original studies were conducted in the United States, usually with profoundly impoverished children in Head Start programs in major cities. This study was not designed to test SES differences; rather, the analysis was performed to ensure that SES was not introducing a bias. Additionally, we may not have accessed many children who were in truly impoverished circumstances, who might not even be in childcare situations.

Summary. ELCC practitioners who work with preschoolers are performing many early literacy and early numeracy activities on a daily basis. The most frequent numeracy activities are counting-oriented and the most frequent literacy activities are language-oriented. Respondents'

beliefs about the optimal way to encourage early learning (i.e., Child-initiated vs. Adult-Guided) and their knowledge of children's capabilities were related to the frequency of performing activities with the children in their care. Thus, beliefs and practices were consistent – those who believe children are not capable of early literacy and early numeracy achievements until they are older, and who also believe these activities must be initiated by the children, reported lower frequencies of early learning activities.

Qualitative Results

Respondents were asked two open-ended questions about their early numeracy and literacy activities. They were asked to indicate any particularly successful activities, and they were asked to indicate unsuccessful activities, or those they used in the past but no longer. Answers to these questions were tabulated and grouped (as much as possible) in an attempt to extract a list of activities that participants were actually using. However, note that they completed this question after reading through the list of practices.

Literacy and Numeracy Activities

Of 768 respondents, 72% reported some successful literacy activities, 68% reported some successful numeracy activities, and 46% reported on *unsuccessful* literacy and numeracy activities. Thus, respondents were willing to share their own experiences in the early learning domain.

The literacy activity that was the most frequently said to be successful and enjoyable was simply reading or telling stories to children, although another group of respondents specified that they encourage children to actively take part in the story by using props, actions, puppets, or sounds, or by discussing pictures and events, pointing out words, and asking questions as the story goes on. Other successful and enjoyable literacy activities include playing games with

letters or words such as hangman or word/letter hunts, and doing a follow up activity after reading a story such as acting it out, creating a puppet show, or asking questions after the story and discussing favourite parts to ensure children understood what was read. Respondents also mentioned, although less frequently, singing songs that use letters, spelling, or rhyming, getting children to create their own stories or books, using pictures or drawings to tell a story, and nursery rhymes.

The successful or enjoyable numeracy activity that was mentioned most frequently was games or activities involving numbers or counting. These activities included building block towers and counting the blocks, counting beads, and hopscotch. Using songs, finger plays, and felt board activities for counting was mentioned by 15%, whereas 6% used these activities for adding and subtracting. Sorting items into categories (e.g., by colour, shape, size, texture) was also a successful activity. Some respondents said they counted items from the environment and their everyday routines such as food, children (e.g., how many boys/girls), steps, toys, bites (while eating a snack), flowers, cars, and trees. Card and board games, including games that use dice, were also popular activities. Puzzles and matching games (e.g., matching a number with the same quantity of items) were also mentioned by some respondents, although less frequently than the previous activities. Only 3% said they read books related to numeracy (either numbers or counting). Many of these activities were mentioned in the practices list, and thus we primed these responses. Nevertheless, the finding that respondents endorsed similar practices suggests that we were successful in developing the list used in the survey.

None of the successful literacy activities that respondents reported involves traditional formal teaching, yet 3% thought that this strategy was successful for teaching numeracy (flash cards, worksheets, printing numbers, rote counting, and drills were mentioned). This suggests a

view of early numeracy as developmentally inappropriate, relative to early literacy, at least among some of the respondents.

The most popular response for unsuccessful literacy or numeracy activities was teacher-initiated or teacher-directed activities involving formal, structured, traditional teaching. This included sitting at a table, paper and pencil work, tests, abstract adding and subtracting, and memorizing. Respondents also "gave up" (as unsuccessful) using worksheets, math workbooks, tracing or printing letters and numbers, rote learning, reciting letters and numbers, and flash cards. Some respondents said they gave up activities that were not age-appropriate, being either too simple for older children (e.g., nursery rhymes) or too complex for younger children (e.g., complex board games).

Closing Comments

Of 768 respondents, 155 respondents wrote a final comment. Of these, 107 were relevant to our data as they pertained to childcare practices or beliefs (the other 48 were either comments about the survey or the questions, or about specific characteristics of their early childhood program).

Of these 107 respondents, most commented that there was room for improvement in their programs, that more literacy and numeracy activities should be integrated into their programs, or that they wanted to know of more activities and how to implement them. However, 14% said that there was no need to improve or change anything because they already had a number of activities and were already doing a good job preparing children for school.

Some respondents (12% of those who provided a final comment) expressed concerns regarding ELCC practitioners' ability to provide both high quality child care and literacy and numeracy activities. These ELCC practitioners were mostly concerned with (a) having very

limited budgets and lack of staff, (b) the lack of qualified and well-trained staff, (c) poor access to high quality resources such as books, games, and toys, and (d) limited opportunity for professional development. Some were concerned with expectations from the school system and parents to do more formal or academic activities, which they did not agree with, whereas other respondents were concerned with not being allowed to better prepare children for school, feeling pressure to only engage in play while not being able to "teach" children.

A small group of respondents (8%) emphasized specifically the need to incorporate more numeracy activities, recognizing that efforts are already being made to promote literacy, but not numeracy activities. However, a further 5% of the sample of respondents believed that skills other than literacy were more important. Thus, some respondents felt that literacy and numeracy activities were appropriate, but that these should not be overdone, whereas others felt that literacy and numeracy activities were not appropriate and that time spent on those activities takes away from learning social skills and other more relevant activities. Thus, there was diversity across individuals as to whether more, less, or the same amount of early literacy and numeracy activities were appropriate in the ELCC setting.

Part V: Discussion

As far as we can tell, this is the first project to gather information about ELCC practitioners' beliefs, knowledge, and practices with respect to early numeracy. It is also the first project to examine literacy in early childcare from a Canadian perspective. The data collected provide a valuable descriptive account of what ELCC practitioners believe, know, and do. The data also provide us with information about the ELCC practitioners themselves, such as years spent in the field, education level, and participation in professional development.

Knowledge

Knowledge of Numeracy and Literacy

We hypothesized that ELCC practitioners may have little awareness of what constitutes 'early numeracy.' It was also hypothesized that ELCC practitioners may not be aware of how to deliver numeracy content using developmentally-appropriate practices. Furthermore, it was hypothesized that ELCC practitioners would feel relatively less knowledgeable about early numeracy than early literacy. Consistent with this prediction, ELCC practitioners indicated that they feel significantly more knowledgeable about literacy than about numeracy.

Professional Development Opportunities

ELCC practitioners attend early numeracy PD activities significantly less frequently than early literacy PD activities. Additionally, ELCC practitioners were significantly less aware of early numeracy PD events than they were of early literacy ones. The reported lack of numeracy knowledge, taken in conjunction with the lack of early numeracy professional development, suggests that ELCC practitioners are aware of the relative gap in their experience and learning. This lack of knowledge may be due in part to a lack of early numeracy PD events, which is implied by their lack of *awareness* about professional development events on this topic. Thus, it

seems that not only are ELCC practitioners less knowledgeable about early numeracy than early literacy, but it also seems that they would have difficulty becoming more knowledgeable, even if they wanted to. This lack of knowledge is consistent with work by LeFevre et al. (in press), which indicated that parents have little awareness of numeracy activities and engage with their children in numeracy activities much less frequently than literacy activities. It is also consistent with finding of Blevins-Knabe et al. (2000) for early childcare practitioners in the United States. Thus, it seems that increasing the availability of numeracy PD may be one way to increase knowledge about numeracy.

Knowledge about Children's Capabilities

Overall, we hypothesized that at least some ELCC practitioners would underestimate children's abilities, and this hypothesis was supported by the results. Survey respondents rated the ages at which children are capable of various early literacy and early numeracy achievements. Cluster analyses separated the sample into two groups: those who tended to view children as capable of these achievements at younger ages (Capable Younger), and those who tended to view children as capable of the same activities at older ages (Capable Older). The median ages provided by the Capable Older cluster tend to reflect North American curriculum targets (e.g., recognize numbers 0 to 100 is in the Grade 1 curriculum in Manitoba and Ontario) rather than the ages at which children have been shown to be capable of these activities within a planned curriculum or intervention.

Based on past research linking years of experience and ELCC practitioner knowledge (Charlesworth et al., 1993; Kowalski et al., 2001; Wang et al., 2008), we hypothesized that years of experience would be related to ELCC practitioners' knowledge. Consistent with this hypothesis, years of experience as a practitioner were significantly related to Capable cluster

membership. Those with 10 or more years experience were more likely to belong to the Capable Younger cluster—the group that believes children are capable of specific numeracy and literacy activities at earlier ages than those in the Capable Older cluster. We speculate that experience with young children allows ELCC practitioners to gain a more accurate picture of children's capabilities, which may explain why their responses were more in line with the research findings on early learning.

Beliefs

We hypothesized that the ELCC respondents would believe that early numeracy practices are less important than similar early literacy skills and less important than social and emotional skills. Indeed, the majority of respondents agreed or strongly agreed that social and emotional development is the primary goal of early childhood education. This finding is consistent with past research indicating that early childhood teachers place less emphasis on basic numeracy and literacy skill development than they place on social and emotional development (Brown et al., 2008; Kowalski et al., 2001; Vartuli, 1999). However, the majority of respondents *also* believed that it is their job to teach children about letters, and they believed that numeracy and literacy skills should be assessed regularly. The majority *disagreed* with the view that children should be allowed to opt out of early literacy and numeracy activities, or that children should only be given formal instruction if they want it. As a group, therefore, our respondents appeared to believe that children's early numeracy and literacy development was important in the early childcare setting. These findings correspond with the perspective that we outlined in Part I—beliefs in developmentally appropriate practices and in child-centered activity can, and in fact do, co-exist with the belief that children need to acquire early literacy and numeracy skills before they start Grade 1.

Our respondents appear to be similar to the Grade 1 teachers in the research described by Vartuli (1999), holding essentially a balanced view of the goals and directions that are appropriate for early childcare settings. It is important to note, however, that our sample was recruited to participate in a survey on early literacy and numeracy; it is certainly possible that individuals who felt that these activities were antithetical to ELCC settings would not have been interested in completing such a survey. Despite this possible bias, however, at least some of our respondents did not have a positive view of early literacy and numeracy activities. One respondent wrote*:" I don't believe that formal teaching of literacy and numeracy is necessary in ECE. Socialization is their job."* Thus, despite the potential bias of the survey context, some respondents were comfortable indicating that they did not view early literacy and numeracy as appropriate for the ELCC setting.

In general, these findings appear to be different from some of the results reported by American researchers (Stipek & Byler, 1997; Vartuli, 1999; Wang et al., 2008). In those studies, ELCC practitioners who taught younger children did not endorse early numeracy and literacy activities. The exception was for practitioners in settings where children were predominately of low SES; there, a greater focus was on making sure children were prepared for school (Ginsburg et al., 2008; Lee & Ginsburg, 2007; Stipek & Byler, 1997). In our sample, in contrast, there was a reasonably high degree of support for integrating early literacy and numeracy activities into ELCC settings, independently of the SES level of the children in the childcare centres.

A cluster analysis of the belief items separated the sample into three clusters, which were labeled Child-Initiated, Adult-Guided, and Moderate. Although individuals in the Child-Initiated cluster tended to agree that children should be learning basic literacy and numeracy skills in childcare programs, they also believed that this learning should be initiated primarily by the

children. The Adult-Guided cluster also thought that children should be learning early academic skills, but they disagreed that children should only receive instruction if they wanted it. The Adult-Guided cluster also disagreed that children should be able to opt out of literacy and numeracy activities, suggesting that they believe that adults should be introducing these concepts and guiding children as they learn. The respondents in the Moderate cluster had beliefs somewhere between the other two groups, resembling the Adult-Guided cluster on some items and resembling the Child-Initiated cluster on others.

The respondents in the Child-Initiated cluster also tended to agree with the belief that "The focus of early numeracy is counting, not math," whereas the Moderate and Adult-Guided clusters tended to disagree with this statement. All three clusters strongly agreed that "reading stories was the best way to learn to read." This belief may be a direct result of the strong messaging to parents and caregivers about the importance of shared reading (Evans & Shaw, 2008). Further, reading to children is a valuable activity, for many reasons, so it is encouraging that the respondents have endorsed this view. Note, however, that research has provided strong evidence that simply reading to children does not help them learn to read (Aram & Biron, 2004; Sénéchal & LeFevre, 2002). This is not to say that this sample of ELCC practitioners does not understand the importance of learning letters—almost 70% believe that it is important for children to know their letters before beginning first grade and they tend to agree that teaching letters, words, and sounds is part of their job. We speculate that ELCC practitioners' conceptions of "learning how to read" are different from researchers' views of this process. It is also possible that practitioners are unaware of the connection between learning letters and sounds and learning how to read.

There were also significant differences between groups on the goal-oriented belief items. The Adult-Guided cluster tended to agree that the most important goal of early childcare programs is preparation for school, while the other two clusters tended to disagree with this statement. Similarly, although all three clusters agreed that social and emotional growth is the primary goal of an early childhood program, the Child-initiated cluster agreed with this statement significantly more than the other two clusters.

These groups are somewhat consistent with previous research using cluster analysis, such as that of Vartuli (1999) and Stipek and Byler (1997), which has cast ELCC practitioners into two polarized belief groups: child-centered or basic-skills. The fact that these analyses identified three groups instead of two is not surprising given the education requirements for many Canadian ELCC practitioners and the time that has passed since the studies cited above were conducted. It seems that the child-centered approach is still fairly dominant in the early child care sector, although the emphasis on the role of early literacy in the last decade may be moderating the negative reaction to the original basic skills items to some extent. Nevertheless, the Adult-Guided group is a much smaller group than the other two.

Relations between Beliefs and Knowledge of Children's Capabilities

The results indicated that beliefs and knowledge of children's capabilities were related to one another. Those in the Child-Initiated belief cluster were also more likely to think that children had to be older to be capable of the specified activities. Thus, it seems that those in the Child-Initiated cluster hold strongly to developmentally-appropriate practices. If they believe that children are not capable of these activities until older ages, it follows that they will be unlikely, and in fact, unwilling, to introduce activities related to early literacy and numeracy until the school-age years.

The notion that ELCC practitioners may be reluctant to introduce literacy and numeracy activities if they believe children are not yet capable of them is supported by their importance ratings of pre-school academic benchmarks. When ELCC practitioners were asked how important it was for children to achieve various numeracy (e.g., count to 10, know simple sums) and literacy (e.g., know all 26 letters, print his or her name) benchmarks before Grade 1, those in the Child-Initiated cluster consistently rated these benchmarks as less important compared to the other clusters. In fact, on *all* of the benchmark items, the Adult-Guided cluster placed significantly more importance on achieving these benchmarks by Grade 1 than the Child-Initiated or Moderate clusters.

Given the disparity between parent and teacher beliefs seen in previous studies, particularly those about low-SES programs (Ginsburg et al., 2008; Lee & Ginsburg, 2007; Stipek & Byler, 1997), we hypothesized that ELCC practitioners would attribute less importance to these benchmarks than parents in previous studies. Although statistical analysis of the parent data with the ELCC data is outside the scope of this study, mean parent importance ratings (LeFevre et al, 2002) tend to be somewhat higher or equivalent to the mean scores of the Adult-Guided cluster and thus higher, overall, than those of the ELCC practitioners. However, further direct comparisons between parents and ELCC practitioners are needed to fully address this issue.

Beliefs and Perceived Literacy and Numeracy Knowledge

As was reported previously, the respondents, as a group, reported confidence in their knowledge about early literacy, and a somewhat lower level of confidence in their knowledge about early numeracy. These differences were not as dramatic as we had initially expected, however. Of more interest were the nuances in beliefs revealed by cluster analysis. Respondents varied in perceived numeracy knowledge by belief cluster, at least for those ELCC practitioners

caring for preschool children. When asked about their own knowledge of early *literacy*, individuals in all three belief clusters (Child-Initiated, Moderate, and Adult-Guided) had similar levels of agreement that they are knowledgeable about this topic. However, the three clusters differed in their confidence about their knowledge of early *numeracy*, with the Adult-Guided cluster reporting higher confidence in their knowledge of this area compared to the other two clusters (Moderate and Child-Initiated). This pattern suggests a relation among practitioners' beliefs, knowledge, and practices that could be addressed through professional development activities and in ELCC training programs.

We hypothesized that math avoidance would be related to ELCC beliefs about the importance of numeracy. Indeed, this hypothesis was supported by the results. The Moderate and Child-initiated clusters feel knowledgeable about literacy, and comfortable with writing, but they feel they lack knowledge about numeracy and are more likely to avoid situations involving mathematics. The Adult-Guided cluster, on the other hand, feels knowledgeable about both numeracy and literacy, and is less likely to avoid situations involving either mathematics or writing. These results suggest sensible, but complex relations among knowledge, beliefs, and self-evaluated skills that would be of considerable interest for further research.

Practices

Respondents reported the frequency of various activities in their childcare programs. Depending on the age of children that they typically cared for, practitioners were directed to a list of practices suitable for infants and toddlers *or* for preschool and school age children. Overall, the practices selected for inclusion in the survey seemed to be appropriate, as many of the items were reported to be quite frequent, while maintaining a sufficient amount of variability for analysis.

Factor analyses were done separately for the infant/toddler and preschool/school-age practices. Within the group of ELCC practitioners caring for toddlers, there were no apparent relations between practices and beliefs, but their practices were related to knowledge of children's capabilities. Thus, of the ELCC practitioners caring for toddlers, those who believe children are capable of numeracy and literacy activities at earlier ages also reported doing more of the advanced activities with the children in their care.

The factors identified within the preschool/school-age practices were labeled: Pre-reading, Language, Quantitative, and Counting. ELCC practitioners reported engaging in fewer pre-reading and quantity activities than language and counting activities, suggesting that although ELCC practitioners engage in many *basic* literacy and numeracy activities, they are doing fewer *advanced* activities within these domains.

One of the key concerns addressed by the DAP philosophy is that of curriculum-child mismatch – the idea that exposing children to content too advanced for their developmental level can be harmful (Graue, 2008; Miller & Smith, 2004). Evidence of this belief is seen in our sample; the ELCC practitioners who believed children are not capable of activities until an older age also showed less evidence of supporting those activities with young children. Respondents who think children are capable at a younger age do significantly more of the activities in every factor (Pre-reading, Language, Quantitative, and Counting).

Practices and Beliefs

Previous research has shown that beliefs are associated with practices, particularly in terms of polarized basic-skills versus a strongly child-centered approaches (Miller & Smith, 2004; Stipek & Byler, 1997). The results of the present research indicated that beliefs were related to practices, and the pattern was the same across the four Practices factors (i.e.,

Language, Pre-reading, Quantities, and Counting). Those who believed childcare programs should be Adult-Guided had higher mean frequencies on all four factors. In other words, the Adult-Guided cluster engaged in these activities more often than individuals in the other two clusters with the children in their care. Conversely, respondents with Moderate and Child-Initiated beliefs reported lower mean frequencies on all four activity factors; thus, these groups did fewer academically-oriented activities overall in comparison to the Adult-Guided group.

An interesting dichotomy exists between the Moderate cluster members beliefs and practices. The original belief patterns for Moderate and Adult-Guided clusters are similar, but for practices, reported frequencies of the early academic activities of the respondents in the Moderate cluster are similar to those of the respondents in the Child-initiated cluster – possibly related to the influence of their program or the administration. The comment below, by a respondent who was in both the Adult-Guided belief cluster and Capable Younger cluster, but who reported relatively low frequencies of the advanced literacy and numeracy practices, captures this dissonance.

> As I have stated, we are not allowed to get these children ready for entering school. We have child-initiated activities all day long, it is nothing but play all day long. I do not agree with our program, and I am seriously considering leaving the day care where I work, and starting my own childcare again.

Beliefs and practices may be inconsistent for other reasons. For example, past research has shown that preschool and kindergarten teachers of middle-SES children sometimes feel pressured by parents to provide instruction that is designed to prepare children for school (Lee & Ginsburg, 2007; Stipek & Byler, 1997). Preschool and kindergarten teachers have also indicated that pressure may come from school and state policies to increase focus on academics. Pressures from external forces are not always consistent with teachers' beliefs (Stipek & Byler, 1997).

Thus, it seems that the childcare program requirements, parental pressures, and policies at the provincial or national level may impact the practices of ELCC practitioners, which may account for some discrepancies between practices and beliefs.

Practices and Avoidance in Mathematics and Writing

We hypothesized that those reporting more math avoidance may have negative feelings towards math, and thus may engage in early numeracy practices less often. In this sample, avoidance orientations were related to the frequency of respondents performing early numeracy and early literacy activities. Results indicated a significant relation between avoidance and frequency across all four of the factor scores for both mathematics and writing. Thus, it seems that the more confidence the respondents feel in their own skills, the more likely they are to perform these activities. This finding is consistent with research done by Musun-Miller and Blevins-Knabe (1998) with *parents* of preschoolers, who found relations between self-efficacy beliefs about mathematics and reported practices. It seems that the ELCC practitioners do not feel confident in their own math skills, which may lead to math avoidance, and may also lead to fewer numeracy activities in the childcare program. These findings are also consistent with previous studies that have shown that adults are likely to avoid mathematics also show a tendency to be less skilled at mathematics (LeFevre et al., 2003). Avoiding activities that involve writing may show similar skill results, although this has not been measured and very few educated adults claim that they avoid writing, or that writing makes them nervous (LeFevre et al., 2003). Thus, although it also possible that writing avoidance may be linked to lower frequencies of literacy activities (practices), but this issue could not be assessed in the present research, as this sample had little variability in its writing avoidance overall.

Relations between Practices and Socio-Economic Status of the Children in ELCC Programs

In the present research, we did not observe any relation between the SES of the children and practices of the ELCC practitioners. Neither the percentage of subsidized children nor percent of impoverished children in the childcare setting showed any relation to frequency of practices. These findings are inconsistent with past research that has found that teachers of low-SES students tend to engage in more basic skills activities, whereas ELCC practitioners caring for middles-SES children tend to focus on social-emotional development (Ginsburg et al., 2008; Lee & Ginsburg, 2007; Stipek & Byler, 1997). There are a number of possible explanations for these results, but the main reason may simply be that previous studies were conducted in the United States, usually with profoundly impoverished children in Head Start programs in major cities. In the present research, no special efforts were made to target disadvantaged children.

Comparisons to Previous Research

This study of Canadian practitioners provides some support for concerns expressed in a recent American social policy report (Ginsberg et al., 2008). Similar to the views elicited in the American studies, ELCC practitioners in Canada do not appear to believe that early numeracy is as important as literacy (e.g., importance ratings for 'do simple sums before Grade 1' are significantly lower than for 'read a few words'). Although counting activities are performed almost daily, most practitioners rarely perform activities involving simple arithmetic or comparing and combining quantities. Consistent with this discrepancy, professional development in early numeracy is less available than all other types of professional development.

Although the sample of respondents in the present research can be characterized similarly to samples from studies done in the U.S., in fact, our analyses found that Canadian ELCC practitioners clustered into three groups – one group who reports doing early mathematics

activities more frequently, is more confident in their own math skills, and has a realistic view of the capabilities of children in terms of both early numeracy and early literacy. This Adult-Guided cluster takes a similar approach to early literacy, more frequently performing activities shown to scaffold development of reading proficiency in the early grades (e.g., teaching letters, drawing attention to print).

The other two clusters, one of which is defined by the belief that activities must be Child-Initiated, are less aware of children's capabilities. Perhaps influenced by their own poorer mathematics skills, they believe that children are not capable of early arithmetic until age 5. Thus, they do not move beyond counting activities because they believe that doing so would not be developmentally appropriate. These ELCC practitioners feel that parents and policy makers do not understand children and DAP practices, as clearly captured in a survey respondent's comment below in response to a question on numeracy practices: "If it is not DAP, I won't do it. It's the parents and politics that are curriculum oriented."

This pattern of results leads to an important opportunity provided by the results of this survey. Given that children learn best in a developmentally appropriate environment, providing training about the early capabilities of children may convince these ELCC practitioners that early mathematics is indeed developmentally appropriate. The comment from a survey respondent below succinctly captures this view:

> Although I would like to include more early literacy opportunities in the preschool I work in (such as letter sound games, environmental print, etc.), the owner has this notion that children are not capable at the preschool age level: 2 1/2 up to 5 years. It is frustrating as the times I am able to introduce early literacy, the children are quite interested and eager to play. … I am looking forward to the new Alberta Child Care Act coming into effect that promotes ECE practices/training.

Knowledge Calibration: Early Numeracy is not Just Counting

We hypothesized that ELCC practitioners may report numeracy activities less frequently than literacy activities. In this Canadian sample, ELCC practitioners do acknowledge that their knowledge of early numeracy is not as strong as for their knowledge of early literacy. However, 60% agree or strongly agree that they are sufficiently knowledgeable about early numeracy. But are they as knowledgeable as they believe? The majority of respondents provided older age estimates for children's capabilities than both the literature and the experienced ELCC practitioners in the sample believe to be appropriate. Only a minority of the sample agreed that 'knowing simple sums' is important before Grade 1, suggesting that they are unaware that early arithmetic is included in most Kindergarten curricula. Although it was not directly assessed, from such findings we may infer that many practitioners are also unaware of the research suggesting that mathematical skills prior to school entry are predictive of later academic performance (as per Duncan et al., 2007; NLSCY, 2008). Of course, even if they were aware of such research, they may feel that early numeracy and literacy activities are not within the purview of the ELCC practitioner. However, our findings suggest a much more generally positive view of a role for teaching about letters and numbers (at least) within the childcare setting than we had initially anticipated. Thus, there is presumably room for dialogue and discussion about exactly how early academic activities can be appropriately accommodated in ELCC settings.

In accord with the generally positive attitudes of the respondents, ELCC practitioners who work with preschoolers are performing many early literacy and early numeracy activities on a daily basis. For most, these activities are characterized as quite basic, including counting-oriented activities for early numeracy and language-oriented early literacy activities.

Practitioner's beliefs about early learning and their knowledge of children's capabilities are related to the frequency of performing most of the related activities with the children in their care.

Prominent Canadian literacy researchers Keith and Paula Stanovich, together with Americans Cunningham and Perry, have studied 'knowledge calibration' - the relation between practitioners' perceptions of their knowledge/skill and measurements of that knowledge/skill. In their study of early literacy with teachers of children in kindergarten to grade 3, they found that the majority of the teachers had only limited knowledge of children's literature, and of phonemic awareness and phonics, yet these teachers rated their knowledge levels quite positively (Cunningham, Perry, Stanovich, & Stanovich, 2004). A similar pattern can be seen in the results of this survey. Respondents rated themselves as sufficiently knowledgeable about early numeracy, yet appeared to take a very limited view of the domain, which is exemplified in the Child-Initiated cluster's agreement that 'the focus of early numeracy is counting, not math'.

Cunningham and colleagues suggest that preservice and inservice training could help teachers become aware of what they do and do not know about early literacy. Although respondents in the present sample seemed to *believe* that children are capable of early mathematics, their perceived knowledge ratings suggest that they may not know how to put their beliefs into practice. Targeting the ELCC community with training on the capabilities of young children may be an effective method of improving practices in Canada; this approach has met with success for elementary teachers of mathematics (e.g., Carpenter, Fennema, Chiang, & Loef, 1989). Because experience appears to contribute to the development of more appropriate notions of children's capabilities in early numeracy, the knowledge calibration gap could be addressed

by presenting this information during preservice training, or in workshops oriented to practitioners in their first few years of working in the field.

We've Thrown out the Worksheets – Now What do we do?

In addition to providing training on children's capabilities, ELCC practitioners need fun and effective early numeracy activities that will increase the chances that children will initiate the activities and reduce the chances that children will 'opt out'. A belief in the view that children should be leading the choice of activities was pervasive amongst at least one third of the present group of respondents. These practitioners believe that paper and pencil activities, and particularly formal printing and arithmetic worksheets, are developmentally inappropriate (cf. Charlesworth et al., 1993; Stipek & Byler, 1997; Vartuli,1999). Indeed, their comments indicate that they have stopped using those types of materials. However, they appear to have replaced or substituted only counting-oriented activities, although some do play card and board games. Many respondents suggested that they want to learn about *other* early numeracy activities, and even that the activities assessed in the survey had given them ideas about what they could do. Deborah Stipek, one of the prominent DAP researchers in the U.S., supports more training on early numeracy. She suggests that training early childhood educators is the key to reducing the avoidance and ineffective practices contributing to the inadequate preparation of many children for the mathematics expected in Grade 1.

Limitations of our study

The data presented here come from surveys completed by ELCC practitioners, and thus responses are from their perspective alone. A large body of existing research in the social sciences has noted that self-report data are subject to social desirability biases. Indeed, Driessen et al. (1997) have suggested that there may be discrepancies between what ELCC practitioners report doing and what they actually do. Driessen et al. recommend using in-depth interviews as

one way to increase the validity of the collected information. Future research would benefit from including the perspectives of other adults who are influential in children's lives, such as parents, who provide literacy and numeracy experiences at home and thus may both complement and extend the activities in the ELCC setting.

It is also important to note that although the sample was large, we know that it is not representative of the Canadian population of ELCC practitioners. For example, a disproportionate number of ELCC practitioners in our sample come from Manitoba; their representation in our sample is larger than their representation in the population of Canada. A non-representative sample is to be expected, as respondents were not randomly selected, but recruited at ELCC conferences, through email, and via a link on the Canadian Child Care Federation webpage.

It is also important to mention that although we know something about the reported frequency of literacy and numeracy activities, we know little about the quality of these activities or how ELCC practitioners actually go about presenting the activities in the childcare setting. Saxe et al. (1987) have noted that the same activity could be performed with differing levels of goal complexity and thus of differing benefit and emphasis. For example, an ELCC practitioner could read a story without engaging children at all, *or* an ELCC practitioner could read the *same* story and ask children to make predictions, explain meanings of new words, ask the children to count, get the children to relate the story to some aspect of their lives, and so forth. Research with shared reading has shown that the quality of interaction during the activity produces different learning outcomes. Examining the effect of quality of instruction can be done through observation or through interventions in which the activities are sequenced and controlled. Thus,

our study is limited in that it does not include any direct observation or assessment of the quality of practices, which is an important direction for future research.

Finally, because they were only asked about their education and the frequency of recent professional development, and were not asked about the quality of these learning experiences, we also know nothing about the quality of training that the ELCC practitioners received during their education or during professional development. Analysis of existing ELCC training programs and existing professional development opportunities would greatly enrich the picture of such opportunities for ELCC practitioners in Canada.

Recommendations and Conclusions

The goal of the present research was to document the knowledge, beliefs, and practices of ELCC practitioners in Canada with respect to early literacy and numeracy. Our survey showed that practitioners are generally favorable towards the inclusion of relevant activities in the childcare setting, but also illustrated that practitioners' beliefs and knowledge are crucial in understanding the types and frequencies of these activities. Based on the relative lack of early numeracy knowledge, and the low availability of early numeracy professional development that was reported, we can recommend that early numeracy PD be designed and offered as widely as possible. Instruction in early numeracy should also become a key component in training programs for early childhood educators.

Clements (2004b) has suggested that curriculum standards for early childhood education should be based on research and known practice. Clements believes that these curriculum standards should operate as guidelines, which, because young children can vary greatly in their capabilities, would include a *range* of outcomes that are developmentally appropriate. Of course, this approach assumes that ELCC practitioners are knowledgeable about children's early

numeracy capabilities. Thus, it is critical to provide practitioners with a greater understanding of children's learning trajectories, specifically, knowledge about when *most* children are expected to be capable of learning various concepts and skills. Knowing more about learning trajectories would also prevent redundant school instruction that is focused on material that children already understand (Clements, 2004b).

Research suggests that young children are inherently interested in numeracy activities, as most young children engage in math-related activities during free play (Seo & Ginsburg, 2004). Creating early learning programming to foster early numeracy involves taking everyday activities and re-structuring them to provide conceptual understanding (Clements, 2004a). It is through developmentally appropriate and hands-on experiences that children are able to take intuitive understandings and develop a more complex and abstract mathematical knowledge.

The expert panel on early mathematics in Ontario (Early Math Strategy, 2003) suggested that an effective mathematics learning environment should have many specific characteristics. Such an environment should include a variety of learning resources, demonstrate positive beliefs and attitudes towards mathematics, attempt to connect prior knowledge to new concepts and explore concepts through problem solving. Although this description was intended to describe a school environment (e.g., kindergarten), similar characteristics could be incorporated into childcare settings. Providing young children with numeracy resources and encouraging concept development in everyday activities will likely help create the foundation upon which children build understanding through formal math instruction.

It is likely that ELCC practitioners can influence children's attitudes towards literacy and numeracy activities. Thus, ELCC practitioners should strive to convey a positive attitude towards these topics. As shown in the current study, some ELCC practitioners dislike or even avoid math

(see also Ginsburg et al., 2008) and thus they may convey negative feelings about early numeracy to the children in their care (Early Math Strategy, 2003). Such attitudes are best addressed by providing professional development opportunities that demonstrate and reinforce the practitioners' own capabilities in the domain of early mathematics.

In recent years, researchers have begun to develop early mathematics education programs that are based on research showing children's capabilities in this domain (Clements & Sarama, 2007; Griffin, 2004; Starkey, Klein, & Wakeley, 2004). For example, Griffin (2004) has developed a mathematics program called "Number Worlds" that teaches children about counting, quantity, and formal mathematical symbols, and about the ways that math and quantity are used in societal contexts. The activities for each age group are designed to be within the developmental capabilities of most, if not all, children of that age. Children are able to move forward at their own pace, but teachers or ELCC practitioners provide scaffolding to encourage more advanced learning. Evaluations of the Number Worlds program have found that low-SES children receiving the program consistently outperformed the control groups on math achievement tests. This is just one example of a mathematics program designed for young children that could be adapted and used in the childcare setting.

References

Aram, D., & Biron, S. (2004). Joint storybook reading and joint writing interventions among low SES preschoolers: Differential contributions to early literacy. *Early Childhood Research Quarterly, 19*(4), 588-610.

Arnold, D. H., & Doctoroff, G. L. (2003). The early education of socioeconomically disadvantaged children. *Annual Review of Psychology, 54*, 517-545.

Ashcraft, M. H., & Ridley, K. S. (2005). Math anxiety and its cognitive consequences: A tutorial review. In J. I. D. Campbell (Ed.), *Handbook of mathematical cognition* (pp. 315-327). New York: Psychology Press.

Aunio, P., Niemivirta, M., Hautamäki, J., Van Luit, J. E. H., Shi, J., & Zhang, M. (2006). Young children's number sense in China and Finland. *Scandinavian Journal of Educational Research, 50*(5), 483-502.

Aunola, K., Leskinen, E., Lerkkanen, M. K., & Nurmi, J. E. (2004). Developmental dynamics of math performance from preschool to grade 2. *Journal of Educational Psychology, 96*, 699-713.

Baroody, A. J., & Ginsburg, H. P. (1983). The effects of instruction on children's understanding of the "equals" sign. *The Elementary School Journal, 84*(2), 199–212.

Baroody, A. J. (2004). The developmental bases for early childhood number and operations standards. In D. Clements, J. Sarama & A. DiBiase (Eds.), *Engaging young children in mathematics* (pp. 173-216) Lawrence Erlbaum Associates.

Baroody, A. J. (1987). The development of counting strategies for single-digit addition. *Journal for Research in Mathematics Education, 18*(2), 141-157.

Baroody, A. J., Lai, M., & Mix, K. S. (2006). The development of young children's early number and operation sense and its implications for early childhood education. *Handbook of research on the education of young children* (2nd ed.,). (pp. 187–221). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Bisanz, J., Sherman, J. L., Rasmussen, C., & Ho, E. (2005). Development of arithmetic skills and knowledge in preschool children. In J. I. D. Campbell (Ed.), *Handbook of mathematical cognition* (pp. 143-162). New York: Psychology Press.

Bjorklund, D. F., Hubertz, M. J., & Reubens, A. C. (2004). Young children's arithmetic strategies in social context: How parents contribute to children's strategy development while playing games. *International Journal of Behavioral Development, 28*, 347-357.

Blevins-Knabe, B., Berghout, A. A., Musun, L., Eddy, A., & Jones, R. M. (2000). Family home care providers' and parents' beliefs and practices concerning mathematics with young children. *Early Child Development and Care, 165*, 41-58.

Bracken, S. S., & Fischel, J. E. (2006). Assessment of preschool classroom practices: Application of Q-sort methodology. *Early Childhood Research Quarterly, 21*(4), 417-430.

Brannon, E. M. (2005). What animals know about number. In J. I. D. Campbell (Ed.), *Handbook of mathematical cognition* (pp. 85-108). New York: Psychology Press.

Brown, E. T., Molfese, V. J., & Molfese, P. (2008). Preschool student learning in literacy and mathematics: Impact of teacher experience, qualifications, and beliefs on an at-risk sample. *Journal of Education for Students Placed at Risk, 13*(1), 106-126.

Bushnik, T. (2006). *Children and youth research paper series: Child care in Canada*. Canada: Statistics Canada.

Butterworth, B. (2005). The development of arithmetical abilities. *Journal of Child Psychology and Psychiatry, 46*(1), 3-18.

Buysse, V., Wesley, P. W., Snyder, P., & Winton, P. (2006). Evidence-based practice: What does it really mean for the early childhood field? *Young Exceptional Children, 9*, 2-10.

Campbell, F. A., Pungello, E. P., Miller-Johnson, S., Burchinal, M., & Ramey, C. T. (2001). The development of cognitive and academic abilities: Growth curves from an early childhood educational experiment. *Developmental Psychology, 37*(2), 231-242.

Canada. (2006). *The kindergarten program*. Toronto, ON: Author: Ontario Ministry of Education.

Carpenter, T. P., Ansell, E., Franke, K. L., Fennema, E., & Weisbeck, L. (1993). Models of problem solving: A study of kindergarten children's problem solving processes. *Journal for Research in Mathematics Education, 24*(5), 428-441.

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C. P., & & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Education Research Journal, 26*, 499-531.

Carpenter, T., Fennema, E., Franke, M., Levi, L., & Empson, S. (1999). *Children's mathematics: Cognitively guided instruction*. Portsmouth, NH: Heinemann.

Charlesworth, R., & Lind, K. (1999). *Math and science for young children* (3rd ed.). Albany, NY: Delmar.

Charlesworth, R., Hart, C. H., Burts, D. C., Thomasson, R. H., Mosley, J., & Fleege, P. O. (1993). Measuring the developmental appropriateness of kindergarten teachers' beliefs and practices. *Early Childhood Research Quarterly, 8*(3), 255-276.

Clements, D. H. (2004a). Preface. In D. H. Clements, J. Sarama & A. M. DiBiase (Eds.), *Engaging young children in mathematics* (pp. ix-xv). Mahwah, NJ: Lawrence Erlbaum Associates.

Clements, D. H. (2004b). Major themes and recommendations. In D. H. Clements, J. Sarama & A. DiBiase (Eds.), *Engaging young children in mathematics* (pp. 7-72). Mahwah, NJ: Lawrence Erlbaum Associates.

Clements, D. H., & Sarama, J. (2007). Effects of a preschool mathematics curriculum: Summative research on the building blocks project. *Journal for Research in Mathematics Education, 38*, 136-163.

Clements, D. H., Swaminathan, S., Hannibal, M. A. Z., & Sarama, J. (1999). Young children's concepts of shape. *Journal for Research in Mathematics Education, 30*(2), 192-192.

Crespo, S. (2000). Seeing more than right and wrong answers: Prospective teachers' interpretations of students' mathematical work. *Journal of Mathematics Teacher Education, 3*, 155-181.

Cunningham, A. E., Perry, K. E., Stanovich, K. E., & Stanovich, P. J. (2004). Disciplinary knowledge of K-3 teachers and their knowledge calibration in the domain of early literacy. *Annals of Dyslexia, 54*(1), 139-139.

Denton, K., & West, J. (2002). *Children's reading and mathematics achievement in kindergarten and first grade* No. NCES2002125, National Center for Education Statistics.

Desoete, A., & Grégoire, J. (2006). Numerical competence in young children and in children with mathematics learning disabilities. *Learning and Individual Differences, 16*, 351-367.

Driessen, G. W. J. M. (1997). Pre-reading and pre-arithmetic instruction in infant education in The Netherlands: A multilevel analysis approach. *Early Child Development and Care, 134*(1), 1.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., et al. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428-1446.

Evans, M. A., & Shaw, D. (2008). Home grown for reading: Parental contributions to young children's emergent literacy and word recognition. *Canadian Psychology/Psychologie Canadienne. Special Issue: Literacy Development in Canada, 49*(2), 89-95.

Friendly, M., Beach, J., Ferns, C., & Turiano, M. (2007). *Early childhood education and care in Canada 2006* (7th ed.) Childcare Resource and Research Unit.

Frydman, O., & Bryant, P. (1988). Sharing and the understanding of number equivalence by young children. *Cognitive Development, 3*(4), 323-323.

Fuson, K. C., & Murray, C. (1978). The haptic-visual identification, construction, and drawing of geometric shapes by children aged two to five: A Piagetian extension. In R. Lesh, & D. Mierkiewicz (Eds.), *Recent research concerning the development of spatial and geometric concepts* (pp. 49-83). Columbus, OH: Information Reference Center, The Ohio State University.

Fuson, K., Richards, J., & Briars, D. (1982). The acquisition and elaboration of the number word sequence. In C. J. Brainerd (Ed.), *Children's logical and mathematical cognition: Progress in cognitive development* (pp. 33-92). New York: Springer-Verlag.

Geary, D. (1994). *Children's mathematical development: Research and practical applications*. Washington, D.C.: American Psychological Association.

Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Mathematics education for young children: What it is and how to promote it. *Social Policy Report: A Publication of the Society for Research in Child Development, 22*(1), 1-23.

Ginsburg, H. P., Bempechat, J., & Chung, Y. E. (1992). Parent influences on children's mathematics. In T. G. Sticht, M. J. Beeler & B. A. McDonald (Eds.), *The intergenerational transfer of cognitive skills, vol. 1: Programs, policy, and research issues; vol. 2: Theory and research in cognitive science.* (pp. 91-121). Westport, CT, US: Ablex Publishing.

Ginsburg, H. P., Cannon, J., Eisenband, J., & Pappas, S. (2006). Mathematical thinking and learning. In K. McCartney, & D. Phillips (Eds.), *Blackwell handbook of early childhood development.* (pp. 208-229). Malden, MA, US: Blackwell Publishing.

Ginsburg, H. P., & Russell, R. L. (1981). Social class and racial influences on early mathematical thinking. *Monographs of the Society for Research in Child Development, 46*(6), 69.

Graue, E. (2008). Teaching and learning in a post-DAP world. *Early Education and Development. Special Issue: Teaching in Early Care and Education, 19*(3), 441-447.

Green, S. D., Peterson, R., & Lewis, J. R. (2006). Language and literacy promotion in early childhood settings: A survey of center-based practices. *Early Childhood Research and Practice, 8*(1), 27-47.

Griffin, S. (2004). Number worlds: A research-based mathematics program for young children. In D. H. Clements, J. Sarama & A. M. DiBiase (Eds.), *Engaging young children in mathematics* (pp. 325-340). Mahwah, NJ: Lawrence Erlbaum Associates.

Howe, N., & Jacobs, E. (1995). Child care research: A case for Canadian national standards. *Canadian Psychology Psychologie Canadienne, 36*(2), 131-148.

Huttenlocher, J., Jordan, N. C., & Levine, S. C. (1994). A mental model for early arithmetic. *Journal of Experimental Psychology: General, 123*(3), 284-296.

Jordan, N. C., Kaplan, D., Locuniak, M. N., & Ramineni, C. (2007). Predicting first-grade math achievement from developmental number sense trajectories. *Disabilities Research & Practice, 22*, 36-46.

Jordan, N. C., Huttenlocher, J., & Levine, S. C. (1992). Differential calculation abilities in young children from middle- and low-income families. *Developmental Psychology, 28*(4), 644-644.

Klein, A., Starkey, P., & Wakely, A. (1999). *Enhancing pre-kindergarten children's readiness for school mathematics*. Washington: DC: Department of Education.

Knudsen-Lindauer, S. L., & Harris, K. (1989). Priorities for kindergarten curricula: Views of parents and teachers. *Journal of Research in Childhood Education, 4*(1), 51-61.

Kowalski, K., Pretti-Frontczak, K., & Johnson, L. (2001). Preschool teachers' beliefs concerning the importance of various developmental skills and abilities. *Journal of Research in Childhood Education, 16*(1), 5-14.

Lee, J. S., & Ginsburg, H. P. (2007). Preschool teachers' beliefs about appropriate early literacy and mathematics education for low- and middle-socioeconomic status children. *Early Education and Development, 18*(1), 111-143.

Lee, J. S., & Ginsburg, H. P. (2007). What is appropriate mathematics education for four-year-olds?: Pre-kindergarten teachers' beliefs. *Journal of Early Childhood Research, 5*(1), 2-31.

LeFevre, J., Clarke, T., & Stringer, A. P. (2002). Influences of language and parental involvement on the development of counting skills: Comparisons of French- and English-speaking Canadian children. *Early Child Development and Care, 172*, 283-300.

LeFevre, J., DeStefano, D., Coleman, B., & Shanahan, T. (2005). Mathematical cognition and working memory. In Campbell, J. I. D. (Ed.), *Handbook of mathematical cognition* (pp. 361-378). New York: Psychology Press.

LeFevre, J., Kamawar, D., Bisanz, J., Skwarchuk, S., Smith-Chant, B., Fast, L., et al. (2008). Conceptual knowledge of counting: How relevant is order irrelevance? In B. C. Love, K. McKrae & V. Sloutsky (Eds.), (Austin, TX: Cognitive Science Society ed., pp. 1356-1364).

LeFevre, J., Penner-Wilger, M., Pyke, A., Shanahan, T., Deslauriers, W., Trbovich, P., et al. (2006). *A Calculated Risk: Is Arithmetic Skill Declining in Canada?* Poster Prepared for Brain, Behaviour and Cognition Society, Saskatoon.

LeFevre, J., Skwarchuk, S., Smith-Chant, B. L., Fast, L., Kamawar, D., & Bisanz, J. (in press). Home numeracy experiences and children's math performance in the early school years. *Canadian Journal of Behavioural Science/Revue Canadienne Des Sciences Du Comportement.*

LeFevre, J., Kulak, A. G., & Heymans, S. L. (1992). Factors influencing the selection of university majors varying in mathematical content. *Canadian Journal of Behavioural Science/Revue Canadienne Des Sciences Du Comportement, 24*(3), 276-276.

LeFevre, J., Smith-Chant, B. L., Hiscock, K., Daley, K. E., & Morris, J. (2003). Young adults' strategic choices in simple arithmetic: Implications for the development of mathematical representations. In A. J. Baroody, & A. Dowker (Eds.), *The development of arithmetic*

concepts and skills: Constructing adaptive expertise. (pp. 203-228). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Lonigan, C. J., & Whitehurst, G. J. (1998). Relative efficacy of parent and teacher involvement in a shared-reading intervention for preschool children from low-income backgrounds. *Early Childhood Research Quarterly, 13*(2), 263-290.

Ludwig, J., & Phillips, D. (2007). The benefits and costs of head start. *Social Policy Report: A Publication of the Society for Research in Child Development, 21*(3), 3-11.

Mandel, E., Osana, H. P., & Venkatesh, V. (2008). Vocabulary acquisition techniques for grade one: An experimental investigation of shared reading vs. reciprocal teaching. *Paper Presented at the Annual Meeting of the American Educational Research Association,* New York.

McMullen, M. B., Elicker, J., Goetze, G., Huang, H., Lee, S., Mathers, C., et al. (2006). Using collaborative assessment to examine the relationship between self-reported beliefs and the documentable practices of preschool teachers. *Early Childhood Education Journal, 34*(1), 81-91.

Millard, R., & Waese, M. (2007). *Language and literacy, from birth...for life* (Research Summary). Ontario: Canadian Language and Literacy Research Network.

Miller, L., & Smith, A. P. (2004). Practitioners' beliefs and children's experiences of literacy in four early years settings. *Early Years an International Journal of Research and Development, 24*(2), 121-121.

Missall, K. N., & Hojnoski, R. L. (2008). The critical nature of young children's emerging peer-related social competence for transition to school. In W. H. Brown, S. L. Odom & S. R.

McConnell (Eds.), *Social competence of young children: Risk, disability, and intervention.* (pp. 117-137). Baltimore, MD, US: Paul H Brookes Publishing.

Musun-Miller, L., & Blevins-Knabe, B. (1998). Adults' beliefs about children and mathematics: How important is it and how do children learn about it? *Early Development and Parenting, 7*, 191-202.

National Mathematics Advisory Panel. (2008). *Foundations for success: Report of the national mathematics advisory panel*. Washington, DC: U.S. Department of Education.

Ontario Ministry of Education. (2003). *The report of the expert panel on early math in Ontario.* Retrieved December 19, 2008, from http://www.edu.gov.on.ca/eng/document/reports/math/index.html

Osana, H. P., Rayner, V., Desrosiers, C., & Levesque, A. (2007). The specialized mathematical knowledge of preservice teachers. *Poster Presented at the Annual Meeting of the Canadian Psychological Association,* Ottawa, Ontario.

Passolunghi, M. C., Vercelloni, B., & Schadee, H. (2007). The precursors of mathematics learning: Working memory, phonological ability and numerical competence. *Cognitive Development, 22*(2), 165-184.

Rayner, V., Pitsolantis, N., & Osana, H. P. Mathematics anxiety in preservice teachers: Its relationship to conceptual and procedural knowledge of fractions. *Paper Presented at the Annual Meeting of the Canadian Society for the Study of Education,* Toronto, Ontario.

Rytkönen, K., Aunola, K., & Nurmi, J. (2007). Do parents' causal attributions predict the accuracy and bias in their children's self-concept of maths ability? A longitudinal study. *Educational Psychology, 27*(6), 771-788.

Saxe, G. B., Guberman, S. R., & Gearhart, M. (1987). Social processes in early number development. *Monographs of the Society for Research in Child Development, 52*(2), i-162.

Sénéchal, M. (2006). Testing the home literacy model: Parent involvement in kindergarten is differentially related to grade 4 reading comprehension, fluency, spelling, and reading for pleasure. *Scientific Studies of Reading, 10*(1), 59-87.

Sénéchal, M., LeFevre, J. A., Hudson, E., & Lawson, E. P. (1996). Knowledge of storybooks as a predictor of young children's vocabulary. *Journal of Educational Psychology, 88*, 520-536.

Sénéchal, M., LeFevre, J. A., Thomas, E. M., & Daley, K. E. (1998). Differential effects of home literacy experiences on the development of oral and written language. *Reading Research Quarterly, 33*, 96-116.

Sénéchal, M., & LeFevre, J. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development, 73*(2), 445-460.

Seo, K. H., & Ginsburg, H. P. (2004). What is developmentally appropriate in early childhood mathematics education? lessons from new research. In D. H. Clements, J. Sarama & A. M. DiBiase (Eds.), *Engaging young children in mathematics: Standards for early childhood mathematics education* (pp. 91-104). Mahwah, NJ: Lawrence Erlbaum Associates.

Skwarchuk, S., LeFevre, J., Fast, L., Smith-Chant, B., Bisanz, J., & Kamawar, D. (submitted). How Is mathematics Taught to Canadian children in elementary school? . *Paper Submitted to American Psychological Association 117th Annual Convention, August 2009,* Toronto, Ontario.

Smith, M. (2003). *The impact of classroom factors on mathematical achievement in the primary grades*. Carleton University: Unpublished manuscript.

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1999). *Preventing reading difficulties in young children*. Novato, CA, US: Arena Press.

Starkey, P., Klein, A., & Wakeley, A. (2004). Enhancing young children's mathematical knowledge through a pre-kindergarten mathematics intervention. *Early Childhood Research Quarterly, 19*(1), 99-120.

Steen, L. A. (Ed.). (1997). *Why numbers count: Quantitative literacy for tomorrow's America*. New York: The College Board.

Stevenson, H. W., Lee, S., & Stigler, J. W. (1986). Mathematics achievement of Chinese, Japanese, and American children. *Science, 231*, 693-699.

Stevenson, H. W., Lee, S., Chen, C., & Lummis, M. (1990). Mathematics achievement of children in china and the united states. *Child Development, 61*(4), 1066.

Stipek, D. J., & Byler, P. (1997). Early childhood education teachers: Do they practice what they preach? *Early Childhood Research Quarterly, 12*(3), 305-325.

Stipek, D. J., & Ryan, R. H. (1997). Economically disadvantaged preschoolers: Ready to learn but further to go. *Developmental Psychology, 33*, 711-723.

Stipek, D., & Byler, P. (2004). The early childhood classroom observation measure. *Early Childhood Research Quarterly, 19*(3), 375-397.

Vartuli, S. (1999). How early childhood teacher beliefs vary across grade level. *Early Childhood Research Quarterly, 14*(4), 489-514.

Virginia, V., Wesley, P. W., Snyder, P., & Winton, P. (2006). Evidence-based practice: What does it really mean for the early childhood field? *Young Exceptional Children, 9*, 2-11.

Wang, J., Elicker, J., McMullen, M., & Mao, S. (2008). Chinese and American preschool teachers' beliefs about early childhood curriculum. *Early Child Development and Care, 178*(3), 227-249.

Woodcock, R. W. (1998). *Woodcock reading mastery tests--revised*. Circle Pines, MN: American Guidance Service.

Young-Loveridge, J. M. (1989). The development of children's number concepts: The first year of school. *New Zealand Journal of Educational Studies, 24*(1), 47-64.

Appendix A: Questions from Survey with Randomized Items

Question Content	Web Question Number	Paper Question Number	Question
Beliefs	11	11	"Please rate your agreement with the following statements".
Infant and Toddler Practices	14 and 15	17	"How often did you do the following activities…"
Preschool and above Practices	16 and 17	18	"How often did you do the following activities…"
Games and Books	21 and 22	19 and 20	"Below you will see a list of titles…". Note: Randomized for online survey, alphabetical order for paper survey.
Capable Age	23	21	"Every child develops at his/her own rate. However, we can often identify an age range.."

Appendix B: Details of Survey Recruiting Methods.

Survey participants were recruited via the following methods:

1. Emails were sent out by the research team and CCCF to child care workers and child care centre managers across the country, who then forwarded the email to their acquaintances/team members. The email contained an invitation and a link to the survey site.
2. A notice of the survey was printed in the Spring 2008 issue of the CCCF's *Interaction* magazine. The notice invited participation by CCCF members. Interested members were directed to go to the CCCF site and click on the survey link.
3. A link to the survey was posted on the CCCF site, in both the English and French versions of the site. The French site link was to the French version of the survey.
4. Booths were set up at the 2008 Manitoba Child Care Conference and at the Sea to Sea child care conference in Vancouver to recruit conference participants. Participants were invited to either fill out the survey on-line at computers at the booth or were given a paper copy of the survey. They were asked to return the paper survey before the end of the conference. Incentives were provided to conference participants in the form of packages of snacks or colored pens. On the final day of the conference, participants were provided with a stamped addressed envelope as an alternative to returning the paper survey to the booth.
5. Information sheets were provided to conference participants in the Maritimes who attended the Caring Relationships Childcare Conference in Nova Scotia in late May, 2008.

Appendix C: Frequency of Missing Data in Main Dataset

	Frequency	*Percent*
Complete - no missing data	*682*	*88.8*
Missing Knowledge question	*2*	*0.3*
Missing Benchmarks question	*6*	*0.8*
Missing Practices question	*19*	*2.5*
Missing Capable question (last)	*59*	*7.7*
Total	*768*	*100.0*

Appendix D: Overall Trends in Numeracy versus Literacy

Professional Development: ELCC practitioners in the survey sample attend significantly fewer early numeracy professional development events than early literacy events.

Confidence: Respondents state that they are significantly more likely to avoid situations involving mathematics than situations involving writing. This lack of confidence, and their lack of access to professional development on early numeracy, could contribute to their ratings of themselves as significantly less knowledgeable about early numeracy than about early literacy.

Capabilities: ELCC respondents clustered together as believing children are capable of both early numeracy and early literacy achievements at either a younger age, or at older ages.

Preschool Practices: Activities with the lowest percentages of scores on 'Most days last week' are all mathematical activities, like board games, adding, comparing, and combining. However, basic activities, such as counting and dialogic reading, are performed frequently. When it comes to both pre-arithmetic and pre-reading practices, frequency drops dramatically.

Appendix E: Paper Version of Survey (PDF format)

The following version of the survey was slightly modified from the on-line version to provide the same information in a paper and pencil format. This version was handed out at the conferences in Winnipeg and Vancouver on May 29th - 31st.