The Construction of the Child in the New Push for Mathematics Education in Early Childhood

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This article reports on an analysis of scholarship published over the last 20 years in four journals focused on early childhood education and mathematics education, which examined the discourse around how children are constructed as learners and doers of mathematics. The analysis found that attention to the whole child was minimal, largely as a result of a dominant focus on clinical studies examining family background as a variable in determining children's mathematics performance. This review suggests a need for research on how young children engage in mathematics in their homes and communities and how preservice teachers can learn to teach early mathematics in ways that draw on those resources and meet the needs of the whole child while promoting mathematical growth.

Introduction

In the 1991 three weather systems off the coast of the northeastern United States collided to form what many in the press and popular culture referred to as "the perfect storm". We see a perfect storm emerging in the US in early childhood mathematics education as three forces are colliding to shape how young children might be taught mathematics. Those forces—policies encouraging universal prekindergarten, research on early mathematics, and standards driven practices—have turned researchers', funding agencies', and educators' attention to mathematics learning opportunities for young children. Publically funded prekindergarten in the US has expanded rapidly in the past decade with states eyeing the promise of achievement gap reductions and economic return on investment. Simultaneously, several studies have suggested that early experiences with mathematics

supports later academic performance in all content areas (Duncan, et al., 2007), something policy makers and administrators care about as they compare the performance on international tests of US students to those in other countries. When we situate these in an educational environment dominated by standardized testing and focused on performance, we find ourselves in a perfect storm circling around the mathematics education of preschoolers.

Our concern is that just as the perfect storm in 1991 was a force majeure in terms of damage done to personal property, this perfect storm has also emerged as a sort of *force majeure* with unintended consequences for the education of young children and, with no one liable for the outcome. Although the term, force majeure, has been used historically in legal contracts to rid either party of liability in the event of an act of nature, we find it useful in describing what we see happening in early childhood mathematics education. Definitions of force majeure include notions such as unpreventable, external, unpredictable, and beyond the control, all of which we see as occurring today in the ways that early mathematics education is being framed and, in particular, the ways in which the child as a mathematical being is framed. Thus, while we are embracing the attention that early childhood mathematics education is receiving, we want to raise a warning flag with respect to how the mathematics educators and early childhood educators that teach mathematics methods courses are thinking about children as learners and doers of mathematics. We are particularly concerned that educators from the two paradigms bring with them different resources and understandings about teaching young children, and in the end knowing that mathematics may be privileged over knowing how to teach the whole child. One way to understand how this is playing out is to examine how the bodies of research from early childhood education and mathematics education are framing children.

Discourse as a Window

The research articles published in both mathematics education and early childhood education journals are both *products of* and *producers of* the discourses surrounding early childhood teacher educators. We are not suggesting that teacher educators necessarily read research

articles in order to make decisions about their teaching (although they may), but that these articles provide an empirical window into the discourses available to teacher educators when doing their work.

This view of discourse draws on poststructural theories, which see truth as produced through continual retellings in both spoken and written texts (Foucault, 1990; Parks, 2009). From this perspective, we would expect to see dominant beliefs in the discourse – such as the idea that young children engage in mathematical practices in multiple ways in school, homes, and communities – show up in a variety of ways, such as in discussions of the child in research articles, in informal hallway conversations among university instructors about play as a site of learning, and in collections of objects such as unifix cubes in mathematics education classrooms used for early childhood methods. The more often we see an idea reiterated in the discourse, the more likely the idea is to be taken-as-true by members of the discourse community (Foucault, 1980). In addition, distinctions among discourse communities may be drawn in part by differences in the dominant ideas circulated as truth. For example, making the statement that children progress through predictable developmental stages, which ought to be used as a primary determinant of appropriate instruction would mark the speaker as an insider in some discourse communities (where this statement is taken-as-truth) and as an outsider in other communities (where the falsity of the same statement is taken-as-truth). One of our goals in performing this analysis was to hold the discourses of the early childhood and mathematics education communities up against each other to identify instances where the truth claims of the two communities overlapped and instances where assumptions about truth diverged. Our hope is that doing this not only illuminates the knowledge bases that are being drawn on in the education of early childhood practitioners, but that the analysis also invites insiders in both communities to re-examine their community's truth claims.

Mode of Inquiry

Informed by our theoretical perspective, we drew on methods of textual analysis (Prior, 2003) to examine the content of research articles published about early childhood mathematics education over the last

20 years. Our interest in the differences among scholars who situated themselves primarily in the early childhood community and scholars who situated themselves primarily in the mathematics education community, prompted us to examine two journals in each field, including the *Early Childhood Research Quarterly,* the *Journal of Early Childhood Teacher Education,* the *Journal of Research in Mathematics Education,* and the *Journal of Mathematics Teacher Education.* Although there are numerous journals we could have reviewed, we chose these as the key journals in each field that attend to education research and teacher education research.

We read the titles and abstracts of each research article (editorials, commentaries, book reviews and other short features were excluded) for each target journal published from 1994-2014 to identify articles that addressed both early childhood and mathematics. We operationalized early childhood as attending to children from birth to Age 8 or to preservice or practicing teachers who worked with this population of children. In some cases, judgments about whether to include articles in our dataset were unclear. For example, we included the articles in our dataset if they attended to an area of concern for early childhood teachers, so that a K-12 study about teacher dispositions would be included, but a study that included only a small number of 8-year-olds in the total pool and focused on advanced mathematical content would not be. Using these guidelines, we identified a total of 239 articles of the 1,993 articles we reviewed. The breakdown of these articles by journal is shown in Tables 1. These figures are important to keep in mind throughout the article as we discuss the lack of emphasis on the young child. Even by our generous definitions, about 75 percent of the articles published in mathematics education journals did not address early childhood mathematics in any way. Thus, our claims in the findings section about attention to early childhood contexts are based only on those articles that did claim to address preschool to Grade 3 classrooms or children in some way.

Table 1
Data set: Number of articles from 1994–2014

JOURNAL	TOTAL	EC MATH	PERCENT
Journal of Research in Mathematics Education	353	90	25%
Journal of Mathematics Teacher Educators	307	70	23%
Early Childhood Research Quarterly	737	61	8%
Journal for Early Childhood Teacher Education	596	18	3%
Total	1,993	239	12%

To guide our analysis, we focused on this research question: What discourses about children are circulated in the research literature?

For this analysis we used NVivo, a software program for qualitative data analysis and coded each article for a variety of features, including the specific mathematical content (e.g., number, geometry, etc.), the context of the study (e.g., university, elementary, preschool, out-of-school, clinical-like site etc.), participants of the study (e.g., practicing teachers, preservice teachers, children), and family background or practices. Using NVivo to support our analyses, we identified a variety of relationships (such as a focus on family background addressed in early childhood journals versus mathematics education journals) and identified smaller pools of articles for closer examination (such as all articles that dealt with out-of-school contexts). Our analysis of these smaller pools of articles moved beyond coding and identifying relationships and toward a more holistic analysis of the arguments and assumptions addressed. These analyses were supported by conversations between the authors and through the writing of analytic memos (Emerson, Fretz & Shaw, 1995). The analysis presented below draws on both our coding of the large data set and our close examination of selected texts.

Construction of Children in the Literature

In our analysis of the ways that children were constructed throughout the literature, we identified three important themes framing children as: participants in clinical studies, mathematical beings disconnected from the rest of the child, and members of (dis)advantaged families and communities.

Children as Study Participants

First, children were frequently seen as participants in clinical experiments or interviews, rather than as students in classrooms or as members of families or communities. Of the 239 articles about early childhood mathematics that we identified, 106 of them focused on the experiences of children, rather than preservice or practicing teachers. Of these 106, 29—or slightly less than a third—of the articles described research that took place in clinical contexts. The majority of these studies involved interviews that took place in private settings in school buildings (e.g., Curtis, Okamoto & Weckbacher, 2009; Sophian, 2004), although some were conducted in university laboratories (e.g., Dilworth-Bart, 2012). Studies relying on clinical settings were almost evenly divided between the *Journal of Research in Mathematics Education* and the *Early Childhood Research Quarterly,* suggesting no significant differences between these two communities.

However, one interesting difference pertaining to national context did emerge in relation to clinical studies. While 16 percent of the studies in our total sample took place outside of the US (with roughly the same percentage of the studies focused on children also taking place outside the US), only 6 percent of the studies situated in clinical contexts took place outside of the US This means that the knowledge base for US scholars and teacher educators is even more likely to be influenced by findings produced in clinical settings than that of scholars and educators from other countries. This finding matters because clinical settings are different from early childhood classrooms in a variety of ways: the children's relationship with the adults in the study is short-term, the setting for instruction or assessment is unfamiliar, the social context is often solitary rather than communal; and the concern of the researchers is often focused only on children's cognitive performance. For example, the clinical studies we reviewed typically were conducted by researchers who had no prior relationship with the child outside of the regular classroom setting and were focused on constructs such as "verbal ability" (Dilworth-Bart, 2012), "numeracy skills" (Domitrovich et al., 2013), "mental relationships" (Kato et al., 2002), and "computational resources" (Sherin & Fuson, 2005).

As a result of these important differences, teacher educators drawing on research produced in clinical settings must take care to think more expansively about children as learners when using clinical research as

a knowledge base for teaching practice (Wager, Graue, & Harrigan, in press). Children do not always perform in similar ways in assessment interviews as they do in classroom settings, and in particular, children from non-majority cultures may be impacted by the unfamiliarity of the clinical interview context (Ginsburg & Pappas, 2004). Therefore, results produced in clinical interviews may or may not reflect what will occur in classroom settings. Similarly, the suggestion in the research that all children will follow particular learning trajectories or that certain answers or non-answers in interview settings clearly indicate mathematical understandings (or lack of understandings) could be problematic if it is taken into the teacher education classroom without acknowledgement of the way that context matters in the findings or of the ways that variations in performance are expected across diverse children in typical classrooms. Lack of attention to these important differences in context could leave new practitioners with the idea that there is something "wrong" with their children because they do not behave or answer questions as children in clinical interviews do.

Mathematical Learners in School

Second, children who were not positioned as clinical study participants were typically positioned as mathematical learners in school, less typically as children in school with engagements beyond mathematics, including interest in other content areas, in social relationships, and in physical activities, and less typically still as people with involvements outside the walls of the school. For example, as with many clinical studies, when students were discussed in classrooms, the focus of the researchers was on the cognitive domain, with studies examining the impact of various pedagogies on characteristics like "emergent literacy" (Barnett et al., 2007), "mental models" (Bofferding, 2014), and "participation in discourse" (Empson, 2003). The few studies located in classrooms that did include emotional and social characteristics in their analysis, such as "aggression," (Arnold, Kupersmidt, Voegler-Lee & Marshall, 2012) and "emotional skills" (Bell, Greenfield & Bulotsky-Shearer, 2013) were primarily located in the early childhood journals, again suggesting that mathematics educators may be less likely to consider children's social and emotional experiences as relevant to mathematical learning.

Of the 106 studies focused on the experiences of children, 21 discussed children's experiences outside of the classroom. These studies included analyses of school-based but non-classroom contexts, such as mathematics clubs (e.g., Turner, Dominguez, Malonado & Empson, 2013), descriptions of children's engagements in mathematical tasks in communities (e.g., Schliemann et al., 1998), and examinations of children's mathematical experiences in their homes (e.g., Dearing et al., 2012; Tudge & Doucet, 2004). The studies focused on children's experiences in their homes differed in their stance toward families. Some (e.g., Anderson, Anderson & Shapiro, 2004) sought to describe the kinds of mathematics that occurred during family activities such as playing games, cooking, or reading books. A slightly larger group of studies primarily sought to identify discrete characteristics of home environments in order to link them to mathematics related outcomes, such as linking the spatial skills of parents to those of their children (e.g., Carr, Jessup & Fuller, 1999; Dearing et al., 2012; Manolitsis, Georgiou, & Tziraki, 2013). These differences are important because of the ways that they contribute to how educators at all levels think about children and families. Studies that describe the mathematics that is intertwined with family practices construct a discourse where knowing the rich repertoire of potentially valuable mathematical experiences is important for those seeking to teach young children mathematics (Wager & Delaney, 2014). In contrast, studies that primarily seek to demonstrate links between variables and success in mathematics construct a discourse where the patterns of success and failure in mathematics are put into place before children enter school so that remediation for some children is the only possible intervention strategy. The dominance of studies focused on linking family characteristics to academic performance suggests a need for more research that seeks to identify family practices—within all kinds of families—that might support mathematical learning.

Members of (Dis)advantaged Families

Our third and perhaps most unsettling finding was that one third of the studies focused on children explored the mathematical understanding of children based on their family background. A search of the 31 studies that included family background as one aspect of the

study found that 26 of them mentioned "income" a total of 652 times —one as many as 126 times (Starkey, Klein, & Wakeley, 2004). We find ourselves somewhat conflicted about this, on the one hand we recognize the need to unearth some of the differential learning opportunities available in schools to children from low income families; on the other we found the frequency of this reference problematic as it emphasized research on particular families and particular children. We do want to call attention to the existence of diverse families but believe that constructing diversity *as* a problem *is* a problem. More concerning was that 14 of those articles used the following phrases: disadvantaged children, disadvantaged families, and/or disadvantaged schools. This deficit view of children and families perpetuates the idea that "disadvantaged" or "poor" families do not have the necessary resources to support their children's learning and, therefore, need to be studied. Further, this idea sets up a binary with disadvantaged placed opposite of advantaged. This binary begs the questions: Who are "advantaged" families, children, and schools? Why aren't they being studied? In short, we believe this language of disadvantage has to go.

The majority of the articles attending to family background were in *Early Childhood Research Quarterly,* which may provide some insight into the types of studies the journal privileges—those from large-scale clinical trials in which various aspects of family background is set as a variable against which children's cognitive performance is measured. "Disadvantaged" in these studies was generally defined as low-income, ethnic minorities. For the most part the types of studies reported on in these articles included: comparing the academic functioning of "disadvantaged children" who attended various levels or qualities of preschool (e.g. Domitrovich et al., 2013; van Tuijl & Leseman, 1997) and comparing later learning outcomes after mathematical interventions in preschool (e.g. Starkey, Klein, & Wakeley, 2004).

To dig further into how the child's home experience was constructed in the data set we identified those articles coded for both family background and family practices. In a reading of this subset of the family background articles we found that six took a distinctively deficit view of family practices and four had an asset based view of family practices. The six articles with deficit views examined family practices from a particular perspective (an interview or survey) in which the researchers were looking for specific predetermined behaviors from families. When those behaviors or practices

were not present, the families were deemed as lacking, yet in none of these studies were the culturally bound nature of the expected behaviors discussed. Of the four articles that took as asset based view of family practices, two examined the ways that school practices that built on cultural and community practices provided greater learning opportunities for students (Kisker, et al., 2012; Meaney, Trinick, & Fairhall, 2013). In the other two (Guberman, 2004; Tudge & Doucet, 2004) the researchers went into homes to identify the practices that families engaged with. For example, Guberman compared out-of-school practices of Latino/a and Korean families. His approach was to observe the practices that families *did* engage in and how that connected to school mathematics. We need more of these asset-based studies to develop a different "truth" about children, families, and communities.

Conclusion

Although there were some exceptions, broadly the research we reviewed about early childhood mathematics did not embody the early childhood community's historical concern for educating the whole child, or the equity community's concern for taking asset based views of children and families. For example, in naming important principles that should inform learning in early childhood environments, the National Association for the Education of Young Children (2009) handbook called for attention to "all domains of development and learning—physical, social and emotional, and cognitive," (p. 11), for the promotion of "secure, consistent relationships with responsive adults and opportunities for positive relationships with peers," (p. 13), and for recognition that "play is an important vehicle for developing self-regulation as well as for promoting language, cognition, and social competence" (p. 14). While we would not expect that these themes would be dominant in the research literature focused on mathematics education, we would expect that these themes would influence the kinds of research questions and analyses conducted in early childhood environments, and would therefore be more visible than they were in our review. In addition, we would suggest that those conducting mathematics-related research in early childhood contexts would benefit from attending to the ways that the instructional practices and

treatment of children in their studies does or does not align with broader conceptions of children in the early childhood community.

This brings us back to the perfect storm that is circling around our youngest children. If the way that children are constructed in the literature we reviewed becomes taken as true, we are unlikely to meet the goals that are driving the perfect storm – the hope for equitable mathematical learning opportunities for all children. Further, this force majeure will mean that no one will be responsible for the perpetuation of inequities.

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