The Reset Framework: Examining Critical Factors in Parent-Child Math Participation

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Abstract
Research has shown that parent-child engagement in math activities has a significant positive impact on children's mathematics achievement. Yet, studies also show that parents' mathematics engagement with their young children is largely limited or uninformed. As evidence mounts supporting the importance of kindergarten math-readiness and its role in the future success of students, it is critical that researchers study the ways in which the home numeracy environment (HNE) shapes children's math knowledge in the early years. The present study, through a digital survey and semi-structured interviews, used the RESET Framework (*Role, Expectations, Skills, Efficacy, Time*) to examine the HNEs of 23 parents of four and five-year-old children. The RESET Framework is a new tool that allows for critical examination of the factors that most influence the math-activity participation of parents, and how these different factors may interact with one another to impact parent-child math activity. The results of this study provide researchers with new tools and approaches for studying the HNE, potentially leading to the creation of better parent-engagement programs, increases in parent-child math activity, and higher math achievement for children - especially for those children most at risk for lack of school-readiness.

Keywords: Home Numeracy Environment, School Readiness, Early Childhood Mathematics, Parent Child Interactions, Parent Engagement, Parent Expectations, Early Mathematics

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Introduction

Education stakeholders have worked diligently to help parents understand the importance of the Home Literacy Environment. Unfortunately, awareness-building around the importance of the Home Numeracy Environment (HNE) has been largely ineffective (Blevins-Knabe, 2016). As a result, many parents who support the literacy development of their children may engage with them very little through math. Several studies have shown that parental engagement with children through math has a significant positive impact on students' mathematics achievement, and that the more parents interact with their children through mathematics, and through specific kinds of activities in particular, the more such interactions may lead to improved mathematics outcomes for children (Berkowitz et al., 2015; Gunderson & Levine, 2011; Huntsinger, Jose, Liaw, &Ching, 1997; LeFevre, Clark, & Stringer, 2002; LeFevre et al., 2009; Levine et al., 2010; Niklas & Schneider, 2014; Manolitsis et al., 2013). Yet, studies have also shown that parents' mathematics engagement with their young children is limited, especially when compared to parent-child interactions through literacy (Blevins-Knabe, 2016; Blevins-Knabe & Musun-Miller, 1996; Cannon & Ginsberg, 2008; Musun-Miller & Blevins-Knabe, 1998; Skwarchuk, 2009). Moreover, research on the HNE has been hampered by a lack of validated tools and instruments, common terms and definitions, and best practices in researching this topic (Blevins-Knabe, 2016).

Key Competencies in Early Childhood Mathematics

A number of studies have confirmed the relationship between early math competencies and later school achievement (Claessens & Engel, 2013; Duncan et al., 2007; Nguyen et al., 2016). Significantly, a longitudinal study (n = 781) done by Nguyen and colleagues (2016) found that certain preschool mathematics competences are more predictive of overall fifth grade mathematics achievement, with counting and cardinality competencies being the strongest predictors. Furthermore, specific advanced counting and cardinality competencies (Table 1) were much more predictive of later achievement than basic counting and cardinality competencies.

A Comparison of Simple vs. Advanced Number Concepts and Skills
Adapted from Betts & Son (2020), based on the research of Nguyen et al., (2016)

Math Concepts and Skills	Description & Examples
Simple Number Concepts and Skills	• ***Count sequence***: Child recited the count sequence (eventually up to 10 and beyond: "1…2…3…4…5" • ***Numeral recognition***: Child can recognize and all the numerals from 1 to 10 • ***Count all (one group):*** Given a collection of items within 10, child can count them and label the set: "1…2…3…4…5… there are five pennies!"
Advanced Number Concepts and Skills	• ***Count sequence:*** The child can recite the count sequence beyond 10 and up to 20 (or beyond): "11…12…13…14…15…16" • ***Count all together (two or more groups):*** given two (or more) small groups of items, the child can use counting to determine how many there are altogether, e.g., "You have 2 gummies and 3 fish crackers, how many snacks do you have in all?" • ***Count forward (or backward) from any number:*** Given a starting number other than 1, the child can count forward (or backward), e.g., "Let's start counting from 5, what comes next? 5…6…7…8…9…" • ***Count on (or count back):*** Given the total quantity of one group, the child can count forward to "count on" another group, e.g., "There are three jellybeans in my jar, an now these other jelly beans make…4…5…6…7 total!"

Table 1: Simple vs. Advanced Number Skills and Concepts

Differences in Mathematics Knowledge at School Entry

Children begin school with a wide range of experiences and prior knowledge. Unfortunately, many children begin kindergarten without the requisite knowledge needed to take full advantage of the formal math learning that school has to offer (Betts et al., 2020; Claessens & Engel, 2013, Jordan & Levin, 2009). Consequently, many children are unable to master key math competencies during the kindergarten year, leaving them unprepared for subsequent grades. These disparities in children's math readiness may result from differences in the HNE, primarily "*differences in characteristics of parents, namely their cognitions, practices, and language about math*" (Elliot & Bachman, 2018, p.3).

Development of the RESET Framework

To understand the impact of parents, Hoover-Dempsey and Sandler (1997) developed a model identifying several factors that influence parental involvement, including parent perceptions of their role, sense of efficacy, and invitations to be involved (e.g., from the teacher, school, or the child). This model has evolved to include parents' perceived life context, with particular attention paid to parent perceptions of available time and energy, as well as their own skills and knowledge (Walker et al., 2005). Other research has shown that parental expectations of the child's learning is another important factor influencing parent involvement (DeFlorio & Beliokoff, 2014; Kleemans et al., 2012; Missall et al., 2015; Segers, Kleemans, & Verhoeven, 2015; Skwarchuk et al., 2014). Using this research, the author created the RESET Framework with the domains of *Role, Efficacy, Skills, Expectations,* and *Time*, to integrate these key factors in a meaningful way. The RESET Framework can be used to examine parent involvement in any area of their child's education. However, for this study RESET domains have been specifically defined to reflect math engagement (Table 2).

RESET Dimensions	RESET Framework Scale	
Role: *influenced by parents' early experiences with learning math, their own parents, school, and societal influences. It is socially constructed and may change in response to changing social conditions or efforts (by parent or outside groups, like an intervention program) to alter it.*	**R**	1 2 3 4 Uninvolved — Involved
Expectations: *influenced by parent perceptions of the value of mathematics, it's role in the life of the parent and future life of the child, and their understanding/ awareness of early childhood mathematics.*	**E**	1 2 3 4 Math Unimportant — Math Very Important
Skills & Knowledge: *Parents' perceptions of their own math skills and knowledge impact the ways in which they choose to interact with their children, the types of skills and concepts the emphasize, the expectations they have for their children's math development.*	**S**	1 2 3 4 Low Skills/Knowledge — High Skills/Knowledge
Efficacy: *Parents' perceptions of their own self-efficacy is related to their belief in their ability to successful support the math development of their child. It is influenced by their perceptions of math skills and knowledge and influences their expectations and modes of math engagement.*	**E**	1 2 3 4 Lacks Confidence — Confident
Time & Energy*: Parent engagement in shared math activity is influenced by their perceptions of the time and energy available to participate.*	**T**	1 2 3 4 Unavailable — Available

Table 2: The RESET Framework is informed by the work of Hoover-Dempsey & Sandler (1997), Walker and colleagues (2005), and others. It is hypothesized that patterns of parent perceptions along the RESET dimensions may relate to the mathematical activity participation of parents.

Purpose of this Study

The purpose of this study is to examine the factors that influence parental decisions around interacting with their young children through mathematics, and to test the RESET Framework as a tool for examining the involvement of parents. Specific research questions explored were:

1. How do parents vary in terms of their perceptions of *Role, Expectations, Skills, Efficacy,* and *Time (RESET)?*

2. What patterns or trends emerge among groups of parents in relationship to the RESET domains?

3. What relationships exist between parent perceptions along RESET and parents' self-reports of shared math activity?

Methods & Procedures

Study Design. This exploratory mixed-methods study was reviewed and approved by the University of Buffalo's Institutional Review Board (IRB) for research and employed both a digital survey and a semi-structured interview with individual parents (Figure 1). Parent surveys and interviews were conducted in July of 2019 at the offices of Age of Learning, Inc. (AofL), where the author is an employee. AofL funded sample recruitment, made research staff, facilities and tools available (e.g., interview room, video equipment, etc.) and provided a modest gratuity ($100 Visa gift card) to each parent for their participation. Other than this support, AofL had no role in this study.

Participants. The sample for this study consisted of 23 parents of 4-5-year-old children who had not yet begun Kindergarten. The sample was provided by a panel creation firm, Innovate MR, using their nationwide database. Innovate MR recruited a diverse sample of parents with at least one 4-5-year child who had not yet started formal Kindergarten from the Los Angeles, southern California area in the United States (Table 3).

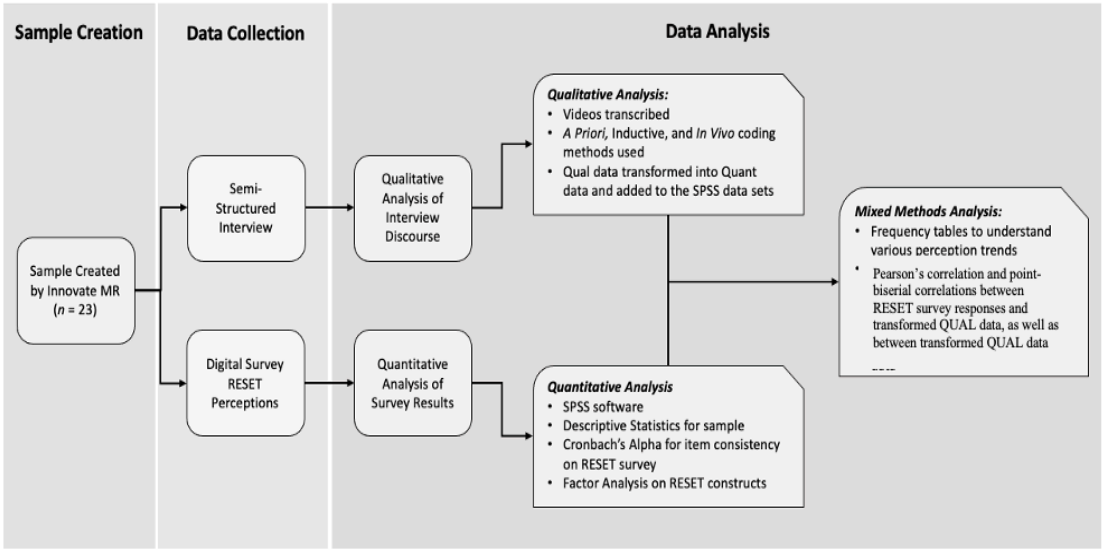

Figure 1: Study Design

Demographic Data for Sample

Demographic Categories	Frequency	Valid Percentage
Gender		
Female	17	73.9
Male	6	26.1
Age		
18-24 yo	1	4.3
25-34 yo	7	30.4
35-44 yo	14	60.9
45-54 yo	1	4.3
Ethnicity		
White	7	30.4
African American	5	21.7
LatinX	8	34.8
Multi-Racial	3	13.0
Education Level		
Some Highschool	1	4.3
Highschool Graduate	2	8.7
Vocational/Technical	4	17.4
Some College	6	26.1
Bachelor's Degree	8	34.8
Graduate Degree	2	8.7
Income Level		
$25,000 - $49,999	8	34.8
$50,000 - $74,999	5	21.7
$75,000 - $99,999	3	13.0
$100,000 - $149,999	4	17.4
$150,000 - $199,999	2	8.7
$200,000 or more	1	4.3
Employment		
Fulltime Stay-at-Home	5	21.7
Employed Part Time	7	30.4
Employed Fulltime	10	43.5
Student	1	4.3
Marital Status		
Single / Divorced / Never Married	7	30.4
Married of Living with Partner	16	69.6

Table 3: Demographics of the Sample

The Digital Survey. The digital survey included three sections: (1) the RESET survey, which included five items per domain, rated using a four-point Likert scale (Figure 2) (2) math activity items, where parents indicated whether or not they engaged in listed math activities (Figure 3), and (3) demographic information, where parents provided additional demographic information about themselves (e.g., education and income levels, marital status, ethnicity, and home language, etc.).

RESET Survey Items

Strongly Disagree (1), Disagree (2), Agree (3), Strongly Agree (4)

Role:

1. It is important for me to talk to my child about math.
2. It's my job as a parent to help my child become a better reader.
3. All parents should push their children to do well in math.
4. It is important for me as a parent to help my child with math.
5. It's my job as a parent to help teach my child new math skills.

Expectations

6. Doing well in math is as important as doing well in reading.
7. It is important to me that my child does well in math.
8. I want my child's teacher to let me know how my child is doing in math in school.
9. Doing well in math leads to success in school and life.
10. I expect my child to do well in math.

Skills

11. I have the math knowledge and skills I need to help my child with math.
12. It is easy for me to learn new math skills
13. I struggled to learn math as a student.
14. I sometimes struggle to do math related tasks in my life.
15. I did well in math when I was a student.

Efficacy:

16. I sometimes feel anxious when helping my child with learning math.
17. I am confident that I can help my child learn math as he or she grows.
18. Sometimes I am nervous when my child asks me questions about math.
19. I feel uneasy when I have to solve a tough math problem.
20. I am confident that I know how to help when my child struggles with math.

Time:

21. I spend time every week doing math activities with my child.
22. I have time to play games with my child.
23. I wish I had more time and energy to play games with my child.
24. I am able to spend time most days doing math activities with my child.
25. I have the energy needed to help my child with his/her learning.

Figure 2: Items arranged by RESET domain. These items were arranged randomly in the survey and were accompanied by a 4pt Likert scale that parents used to rate the strength of their agreement with each statement.

Please check all statements below that are true about your family and home environment:

1. We are able to provide math related toys in our home (e.g., cut out puzzles, shapes, etc.)
2. I often help my child count out groups of up to 5 items (e.g., counting raisins, etc.)
3. Together with my child, we often count aloud to 10 in the correct order
4. I point out shapes in the environment for my child to see (e.g., "look, that plate is a circle.")
5. Together with my child, we sometimes count aloud backwards from 10
6. Together with my child, we sometimes count aloud to 20 in the correct order
7. I help my children learn the names of the written numbers 1 through 10
8. I help my child add up small numbers (e.g., I have 2, you have 3, that's 5 in all!)
9. I often play simple boardgames with my child (e.g., Candyland, etc.)
10. I often play simple card games like Go Fish or Old Maid, with my child

Check all statements below that describe words and ideas you use when talking to your child:

11. I use words like big or small to describe size
12. I use words like more, less, and the same when comparing groups of objects
13. I talk to my child about time concepts like morning and night
14. I use words like after, before, next, later, and soon to describe time relationships
15. I use words like bigger, smaller, longer, and taller to compare things
16. I use words like on top, below, left, and right to describe physical locations
17. I use words like first, second, third and so on to describe positions
18. I'm not sure what words I'm using with my children

Figure 3: MAPP (math activity participation of parents) items from the RESET survey

The Interview. The interview was divided into two parts. Part 1 focused on open-ended questions designed to let parents speak spontaneously about their perceptions of their parental role, their expectations of their child's math performance, their own math skills and knowledge, their confidence (efficacy) in supporting their child's math development, and their perceptions of available time and energy to support the math learning of their child. Part 2 asked parents to elaborate on the types of shared math activities they typically engage in with their child, and to evaluate pairs of common math activities to indicate which one they would more likely do with their child (Figure 4).

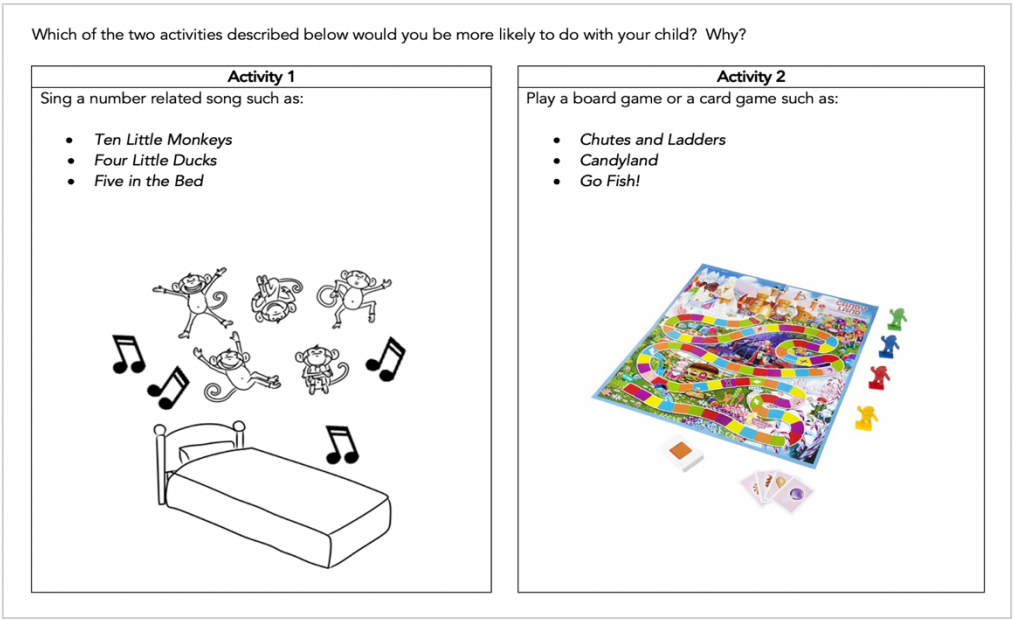

Figure 4: An example of the types of "activity pairs" that parents were shown during the interview.

RESET Domain	Subcode	Description
ROLE		
Level of Responsibility and Accountability.	Proactive	• Saw themselves as responsible for "teaching" their child mathematics.
	Active	• Saw themselves as responsible for actively "partnering" with the child's teacher.
	Passive	• Saw themselves as responsible for **"**encouraging**"** the child, but not actively involved in teaching.
EXPECTATIONS		
Outcome Focus.	Performance Focused	• Focused on "high achievement," "good grades," and being "best in class"
	Effort Focused	• Focused on "putting in hard work," "never giving up," and persisting until they "get it"
	Emotion Focused	• Focused on the child feeling "good about math," "enjoying math," "having confidence," "having fun"
Knowledge of Early Childhood Math.	Simple Number Skills	• Count sequence to 10, recognizing numerals to 10, count all to 10, etc.
	Variety of Concepts/Skills	• Simple number skills as well as some geometry and measurement, spatial understanding and some advanced concepts (below)
	Advanced Number Skills	• Simple number skills as well as count beyond 10 (20, or to 100), count on, count together, count forward or backward from any number
SKILLS		
Parent perceptions of their own math knowledge and skills.	"Strong"	• Believed themselves to have strong math skills, advanced courses in high school and college
	"Good"	• Believed themselves to have good math skills, and capable of handling the mathematics in their lives
	"Ok"	• Believed themselves to have sufficient math skills to get through life, but felt as if low skills had limited their choices
	"Weak"	• Believed themselves to have weak math skills that severely limited their choices and options in their everyday lives
EFFICACY		
Parent levels of math anxiety impacting their perceptions of self-efficacy.	Intense	• When discussing their experience with math, used words like *hate, terrified, scary, overwhelmed, damaging, intimidating*
	Serious	• When discussing their experience with math, used words like *anxious, inadequate, embarrassed, insecure, worried, struggling, lost*
	Moderate	• When discussing their experience with math, used words like *confused, frustrated,* and feelings of negativity toward math
	Mild	• When discussing their experience with math, used words like *difficult, challenging,* and expressed feeling occasional nervousness
	Unspecified	• Did not use any of the above language during the interview when describing their feelings about or experience with math
TIME		
Factors parents perceived to be impacting their time and energy.	Time & Energy Saving Activities	• Parents described needing activities that were convenient to everyday life, family routines, that were active for active children
	Engagement & Interest	• Parents described wanting activities that were of interest to both family and child, so that they took less energy (battling with child) to engage
	Children/Siblings in Home	• Parents described numerous challenges that arose from the presence of siblings in the home (e.g., other children's needs for attention, or activities and schedules of other children in the home making it difficult to make time, or have the energy, to engage in math with their 4-5-year-old child)

Table 3: Subthemes that emerged during qualitative coding

Data Collection and Analysis

Survey data were collected digitally and then analyzed using SPSS software. Internal consistency of the items for each RESET domain were examined using Cronbach's alpha. Interviews were video-recorded and then transcribed using Transperfect software. Video transcriptions and detailed researcher notes were analyzed using categorical strategies to confirm *a priori* themes (i.e., RESET), as well as to identify emergent themes. While RESET was used as a broader hypothesis, many sub-themes emerged within the five RESET domains as a result of this analysis (Table 4). Qualitative data were then transformed into quantitative data using dummy or ranked

codes, or transformed using categorical strategies. These data were then compared each other and with the survey data using various statistical tests, including frequencies and tests of correlations (e.g., Pearson's correlation, point-biserial).

Results

Reliability of RESET survey items was assessed using Cronbach's alpha. Unreliable items were removed to increase Cronbach's alpha for each domain, with final values equal to: *Role* $\alpha = 0.609$; *Expectations* $\alpha = 0.537$*; Skills* $\alpha = 0.922$*; Efficacy* $\alpha = 0.790$*; Time* $\alpha = 0.737$. Parent responses for each RESET domain were averaged to achieve a mean score for each individual domain. These means were examined for patterns and trends and mapped onto individual and collective graphs for visualization purposes (Figures 5, 6, 7).

Graphs of RESET means were also examined for trends and patterns across all parents in the sample, collectively (Figure 6). Though the group of 23 parents was diverse, all parents shared high perceptions of their parental *Role* related to helping their child develop mathematically, with means ranging from 3.0 to 4.0. Parents also shared high *Expectations* for their children, ranging from 3.0 to 4.0, with the exception of one parent. Conversely, parents' perceptions of their own math *Skills* and knowledge, as well as their personal sense of *Efficacy* to confidently support their children's mathematical development, were far more widely dispersed, ranging from 1.2 to 4.0 for *Skills* and from 1.6 to 4.0 for *Efficacy*. Finally, parent perceptions of *Time* and energy available to support their children's mathematics development also varied to some degree.

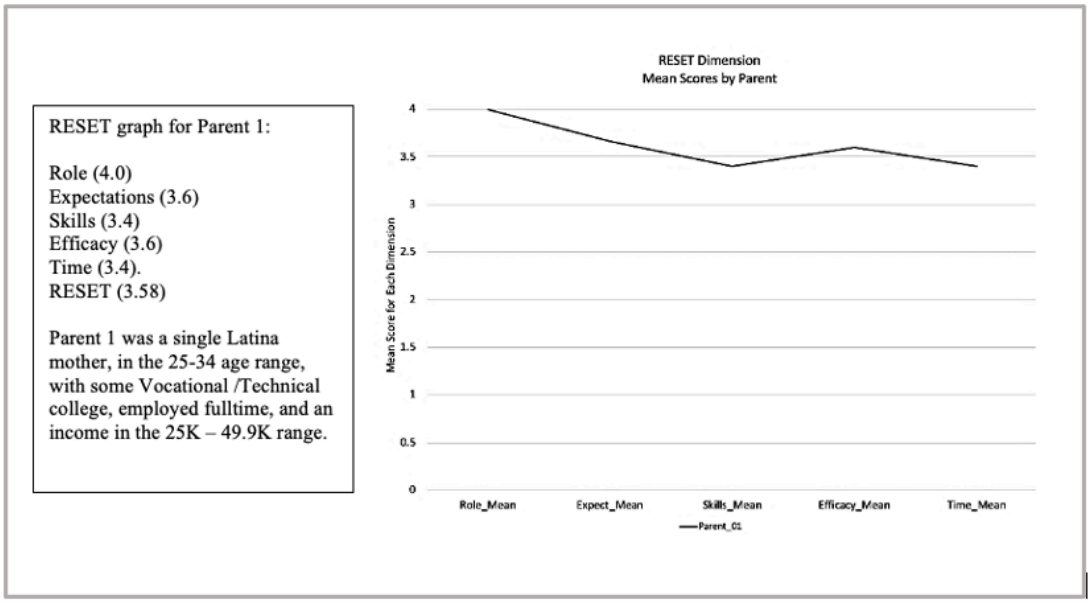

Figure 5: Parent 1 RESET graph

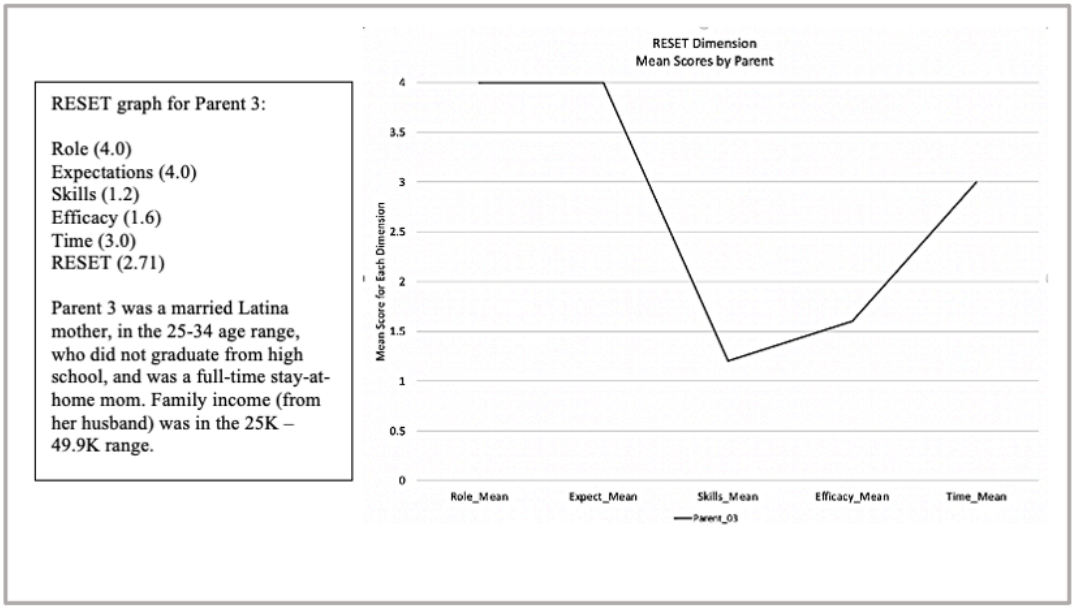

Figure 6: Parent 3 RESET graph

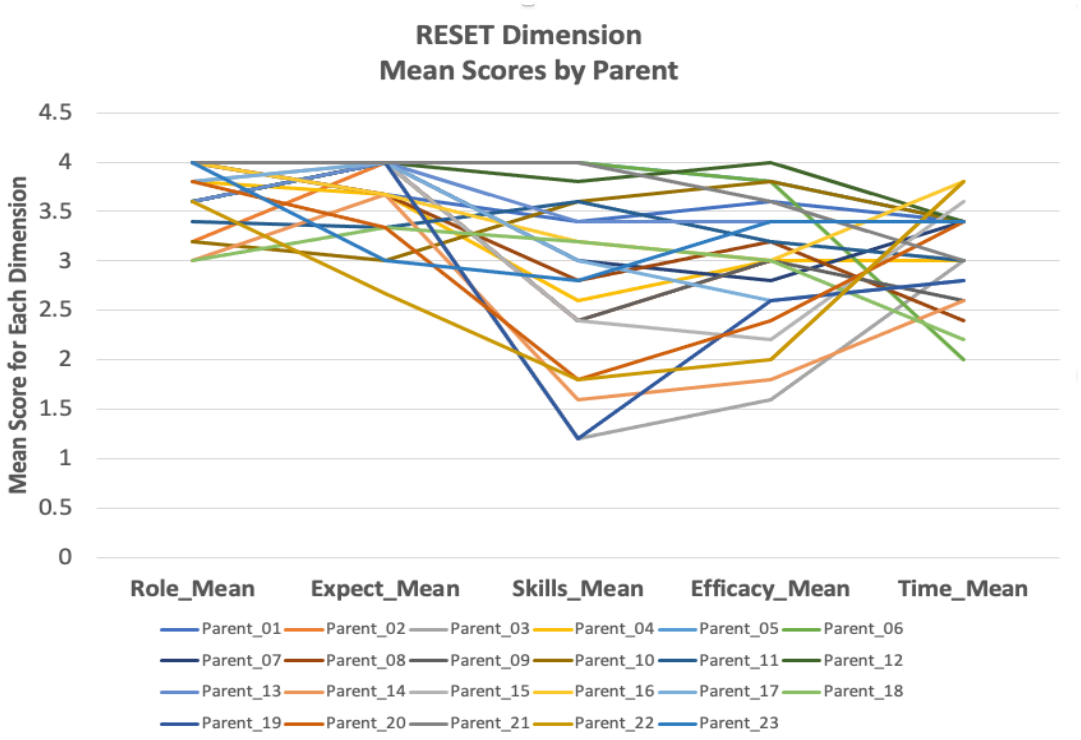

Figure 7: RESET Graph for the entire sample of parents

Role

Parent responses on the RESET survey demonstrated that parents generally perceived themselves to have an involved *Role* in supporting their child's math learning. However, conceptions of "involvement" differed from parent to parent.

By far the largest group of parents in this sample were categorized as *Proactive* parents (47.8 %). These parents exhibited a high degree of personal responsibility for their children's math learning. They proactively taught and reinforced various math concepts

and skills, partnered with preschool or prekindergarten teachers, and showed their children that they valued mathematics learning and deemed it important.

Parents grouped into the *Active* category (26.1%), exhibited a moderate sense of personal responsibility and accountability. *Active* parents were willing to step in as needed, especially if they felt their child needed help, was struggling, or needed more practice. These parents looked more to the child's preschool or prekindergarten teachers for guidance and were happy to follow the teachers' lead by ensuring that their child completed assignments or activities.

Passive parents (26.1%) exhibited a low sense of personal responsibility. They were much less focused on math learning, and more focused on supporting and encouraging their child's efforts. They described a much less active role in helping their children learn math, instead relying on teachers and the environment to expose their children to math concepts. Parents in this group were more likely to lean on math toys (e.g., puzzles, blocks), but not explicitly use such resources to build their children's math knowledge. They were also more likely to depend on older children to help out the 4-5-year-old child with math concepts and skills.

Expectations

Parents' *Expectations* were categorized as *Performance Focused, Effort Focused,* and *Emotion Focused,* or some combination of the three. *Performance-Focused* parents (17.4%) expected their children to exhibit high achievement, earn "good grades," and be "top of their class." *Effort-Focused* parents (17.4%) expected their children to "put in the hard work," to "never give up," and to "keep trying until [they] get it." *Emotion-Focused* parents (26.1%) centered their expectations around the feelings they hoped their child would develop for math, which parents described as "feeling good about math," or viewing math as something they could "have fun" or "enjoy" doing. Parents in the *Emotion-Focused* category further expressed the hope that their children would not "hate math" or be "afraid of math." Other parents expressed a combination of expectations (Figure 7). Overall, parents considered developing positive emotional connections to mathematics a priority.

Parents' understanding of early childhood mathematics was limited and could be categorized into three distinct categories: *Simple Number Skills* (34.8%); *Variety of Concepts and Skills* (47.8%); *Advanced Concepts and Skills* (17.4%) (Table 5). Few parents in this sample had clear ideas of which mathematics skills and knowledge were critical for young children. Only the *Advanced* group were engaging in activities involving key math competencies most predictive of later success in mathematics (Nguyen et al., 2016). In other words, 82.6% of the parents in this sample were *not* engaging in these advanced skills. A small exception to this were a few parents in the *Varied* group who mentioned a couple of advanced skills, but were not engaging in them with any regularity.

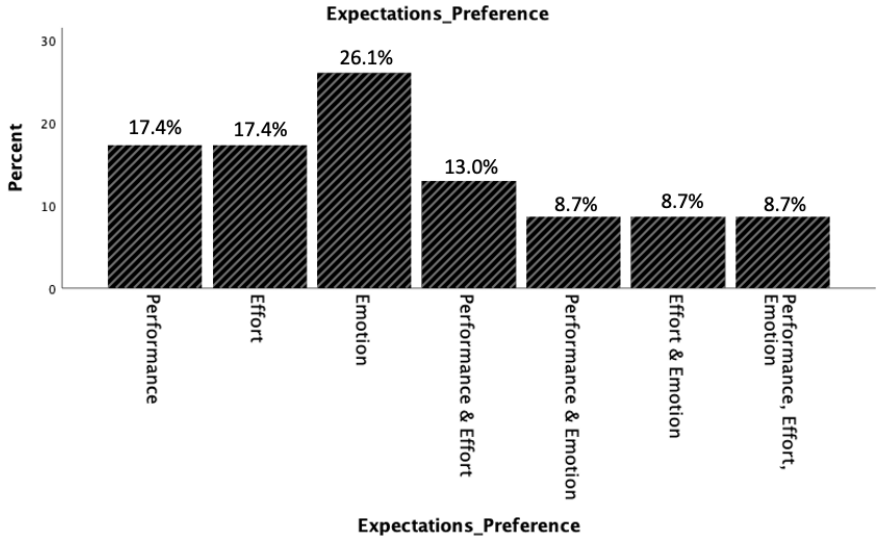

Figure 8: Frequency of various parental performance expectations

Expectations Group	Characteristics	Examples of Activity Types
Simple Number Skills	• Numeral recognition to 10 • Numeral writing to 10 • Count sequence to 10 • Count all to 10 • On occasion these activities might move beyond ten to count to twenty, but not often	• Flash Cards • Worksheets / Workbooks • Counting objects (e.g., fingers, blocks, snacks, etc.) • Singing simple number songs like "One, Two, Buckle My Shoe"
Variety of Concepts & Skills	• Includes most or all of the simple number skills (listed above) • Varied types of measurement • Shape recognition and composition • Sorting by attribute • Visual Spatial activities • Some advanced number skills	• Following a recipe while baking (e.g., 1 cup, 3 tablespoons, 1 teaspoon, etc.) • Counting up coins from a piggy bank (e.g., 10 pennies, 5 nickels, etc.) • Looking for shapes while walking or driving • Playing games like Jenga, or playing with puzzles & blocks
Advanced Number Skills	• All of the simple number skills (listed previously) • Some variety of other math concepts and skills (listed previously) • Advanced counting beyond 10, 20, and often up to 100 • Simple addition and subtraction concepts • Strategy use (e.g., count on, count forward, count backward, etc.)	• Joining or separating groups of objects, as in combining toys, or snacks, etc. • Counting backward when playing a game like "Hide and Seek" or "Tag" • Keeping score during sports like basketball (counting by 2s) • Playing board games (subitization and quick addition with double dice) • Playing card games like War (quickly compare more or less)

Table 4: Types of parental expectations related to early childhood mathematics skills and knowledge

Skills

Parents described their own math skills as *Strong* (17.4%), *Good* (26.1%), *Ok* (21.7 %), or *Weak* (34.8%), suggesting that over half the parents in this sample did not feel confident in their own math skills and knowledge. Parents who described themselves as having *Strong* math skills had higher Skills_Mean scores on the RESET survey (r = 0.492, $p < 0.5$), while no correlations existed for parents who felt they either had *OK* or *Good* math skills. However, there was a highly significantly *negatively* correlated with the Skills_Mean scores on the RESET survey (r = - 0.714, $p < 0.000$). Meaning, there

seemed to be a mismatch for parents who expressed their skills as "weak" in the interview and how they ranked their skills on the survey.

Efficacy

Parents' perceptions of efficacy were closely tied to their feelings of confidence in their math abilities as well as their knowledge of how children develop mathematically. Parents generally had low content knowledge regarding the most important mathematical concepts their children should be learning at this age. Parent perceptions were coded according to the intensity of the language they used to describe their feelings related to mathematics— learning math, doing math, or teaching math to their children (Table 6). Parents' language indicated varying degrees of math anxiety, ranging from expressing "mild discomfort" to feeling "terrified." Over a quarter of the parents (26.1%) did not explicitly express any perceptions of math anxiety through their interview commentary. We cannot conclude from this, however, that these parents were or were not math anxious, only that they did not speak of it in the interview.

Nearly 75 percent of parents in this sample expressed having some level of math anxiety, ranging from mild to intense. Moreover, parent perceptions of math anxiety were highly significantly negatively correlated with parent perceptions of math skills shared in the interview (r = - 0.609, $p < 0.01$). In other words, parents who perceived themselves has having higher levels of math anxiety were more likely to describe themselves as having lower math skills and knowledge. In addition, parent perceptions of math anxiety were highly significantly negatively correlated with parent Efficacy_Means on the RESET survey (r = - 0.603, $p < 0.001$). Meaning, parents who expressed higher perceptions of math anxiety were more likely to rate themselves lower on the *Efficacy* survey items, and vice versa. Lastly, there was a highly significant positive correlation between parents who expressed higher levels of *Math Anxiety* and *Emotion-Focused Expectations* (r = 0.560, $p < 0.001$).

Parent Perceptions of Math Anxiety

Parent Expression of Math Anxiety	Percentage of Parents	Description
Intense	13.0%	• Parent used words such as *hate, terrified, scary, overwhelmed, damaging, intimidating* • Expressed worry that their anxiety was affecting or "damaging" their child • Shared that math anxiety was impacting their everyday lives
Serious	34.8%	• Parent used words such as *anxious, inadequate, embarrassed, insecure, lack confidence, worried, struggling, lost* • Expressed feeling a lack of confidence, or feeling lost
Moderate	17.4%	• Parent used words such as *confused, frustrated* • Expressed feelings of negativity toward math, lacking understanding
Mild	8.7%	• Parent used words such as *difficult, challenging* • Expressed feeling occasional nervousness at times when doing math or helping with math
Unspecified	26.1%	• Parents who did not describe any feelings that were associated with math anxiety • These parents could potentially have math anxiety but did not provide commentary on it.

Table 5: Parents were grouped by level of math anxiety according to the intensity of the language used to describe their feelings.

Time

Parents admitted honestly that finding the time and energy to "do activities" with their children was a challenge. They frequently mentioned wanting *time and energy saving activities* that were "convenient" to everyday living, or that were easily integrated into their family "routines." Parents also mentioned wanting suggestions for math activities that were "more active" or "hands-on" for their children.

Parents were concerned with the *engagement and interest* of their children in math activities. They shared that when their children were not interested in doing an activity it became a battle that caused frustration, wasted time, and ultimately sapped the energy of both the parent and the child. Conversely, a few parents felt that some activities "you just have to do" for "your own good." These sentiments were most often expressed in relation to more formal math activities such as worksheets and flashcards – though some parents did perceive flashcards as "fun." The "fun" of a formal activity seemed to be tied to the parent's ability to transform it into a "game." For example, some parents shared that they pretend to "play school" with flashcards or worksheets.

Parents with *more children in the home*, and more elementary age children in particular (under age 11), expressed having less time and energy for shared math activity with their children. There was a modest negative correlation between the Time_Mean from the RESET survey and children under 11 ($r = -0.400$, $p = 0.059$), meaning parents with more young children felt like they had less time. Additionally, parents who expressed a desire for more "convenient" activities were modestly positively correlated with having children under the age of 11 ($r = 0.399$, $p = 0.60$). While not significant, with a larger sample these relationships might become significant.

Math Activity Participation of Parents

Parents reported engaging shared math activities in varying degrees of frequency. Their self-reports of activity frequency were categorized as *daily*, *weekly*, or *monthly*. These levels of frequency were compared to parents' Time_Means on the RESET survey, as well as other data collected during the interviews. Parents who perceived themselves as having more time were engaging in formal math activities such as worksheets and flashcards ($r = 0.517$, $p < 0.05$), but were engaging in math activities less frequently ($r = -0.484$, $p < 0.05$). Conversely, parents who engaged in more informal activities reported higher levels of activity frequency ($r = 0.438$, $p < 0.05$). Surprisingly, parents who expressed having very little time and energy reported engaging in shared math activity more frequently with a modest, though not significant, positive correlation ($r = .397$, $p = 0.061$).

Math Activity Participation of Parents (MAPP)

Activity Type	Description	Examples
Formal Activities	Activities that have learning mathematics as the explicit, stated, or primary goal.	• Worksheets • Workbooks • Flashcards • Counting with manipulatives
Informal Activities	Activities that do not have math learning as an explicit goal, but where the math is embedded or integrated naturally within the activity itself.	• Boardgames • Card games • Hopscotch • Keeping score during sports • Setting the table • Shopping
Visual-Spatial Activities	Activities specifically related to visual-spatial reasoning, that were *not* being explicitly used to teach or reinforce other math concepts or skills.	• Blocks (e.g., Legos, Megabloks, wood blocks) • Puzzles (e.g., cut-out wood puzzles, jigsaw, etc.) • Games (e.g., Jenga)

Table 6: Math Activity Participation of Parents (MAPP)

Parent-child shared math activity was categorized as *Formal*, *Informal*, or *Visual-Spatial* (Table 7). *Visual-Spatial* activities were categorized separately to account for the ubiquitous presence of blocks and puzzles in most homes, and to allow for a more critical examination of the other two categories. Analyses showed that *Informal* activities were highly significantly negatively correlated with the *Simple Number Skills* approach (r = - 0.554, $p < 0.001$), while significantly positively correlated with the *Advanced Number Skills* approach ($r = 0.503$, $p < 0.05$). In other words, parents who engaged in more *Informal* activities were more likely to expose their children to more advanced number concepts (Tables 1, 5). Additionally, *Visual-Spatial* activities were negatively correlated with the *Simple Number Skills* (r = - 0.517, $p < 0.05$), meaning parents who engaged in more *Visual Spatial* activities were also less likely to focus on simple number skills, but rather a wider variety of math content.

Discussion

Parent involvement in their children's early math learning is vital if we hope to ensure that all children begin kindergarten ready to learn. The RESET Framework, used in this study, provided a mechanism for examining parent perceptions of the factors that most impact parent involvement, and resulted in a number of key findings: (1) parents want to be more involved but need more guidance, (2) parents do not understand what early childhood math is or should be, (3) parents lack awareness of the math learning opportunities in their lives, and (4) parent perceptions of low skills and math anxiety impact their behavior around shared math activity.

Parents want to be more involved but need more guidance

The parents in this sample expressed, at times, an almost desperate desire for more guidance and help in supporting their children's math learning needs. They were eager to be more involved but were uncertain of the best ways to do so. This is consistent with prior research that has shown that parents believe they have a role to play but may still consider mathematics instruction more the domain of the school (Clements &

Sarama, 2014; Sonnenschein et al., 2005). Parents' desire for more guidance, and reliance upon preschool and prekindergarten teachers for that guidance, is complicated by the high prevalence of early childhood educators who lack deep expertise in the area of early childhood mathematics, or who may not be exposing their students to enough mathematics in the classroom (Clements & Sarama, 2014; Early et al., 2010; Li, 2020; Tudge & Doucet, 2004; Winton et al., 2005). Teachers who lack this expertise place both children and families at a disadvantage (Li, 2020), for if teachers are not well-prepared, they are ill-equipped to help parents. As a result, parents who depend on preschool and prekindergarten teachers for meaningful guidance may not receive the support they need.

Parents do not understand what early childhood math is or should be

This study revealed that parents do not have much understanding of the breadth or depth of early childhood mathematics that young children should be exposed to, which may cause them to narrowly focus on simple or varied skills, instead of more critically important advanced number skills (Table 7). This is consistent with earlier findings such as Cannon and Ginsburg (2008) who found that "many parents (74.19%) explicitly stated that they were uncertain about early mathematics learning and teaching. Parents admitted to simply not knowing what mathematics their children could or should learn or how to help them learn it" (p. 252). This uncertainty may further contribute to some parents' perceptions that mathematics should be taught in school rather than at home, undervaluing the critical role of the parent.

Furthermore, parents who are unsure of how to support their children's math learning are likely to engage in math activities that "look" like math, such as workbooks, flashcards, and simple counting activities (Muir, 2012; Muir, 2018). Unfortunately, these types of formal math activities are more likely to emphasize simple number concepts, rather than advanced number concepts. The present study found that parent-child engagement through more informal activities, *not* formal activities, were significantly correlated with exposure to more advanced number concepts—a critical finding—as advanced number concepts are associated with higher degrees of school readiness and later achievement (Claessens & Engel, 2013; Kleemans et al., 2018; Nguyen et al., 2016).

Parents lack awareness of the math learning opportunities in their lives

Parents in this study felt challenged to find opportunities for integrating mathematics engagement and play into their daily lives. This may be a consequence of their limited knowledge of early childhood mathematics; if parents do not know what early childhood math is, they will have difficulty "noticing" opportunities for math learning. As evidence of this, the interview included a review of various common informal math activities (e.g., helping to set the table, playing common card games, sharing snacks fairly), yet many seemed new or unfamiliar to parents.

Parents expressed a desire to make math a part of their daily living but did not necessarily want to conform to some new math activity schedule. Instead, they were eager for more activities that could fit in with daily living. The present study revealed a relationship between the frequency of parent-child shared math activity and engagement in informal activities – a relationship that was not present for formal

activities. Even when parents reported having more time and energy available to spend on shared math activity with their children, those parents who favored formal math activities engaged in shared math activity less frequently. This indicates that when math is organically made part of their lives, parents and children engage in math more frequently, and on more critical skills as well.

Parents' perceptions of low skills and math anxiety impact their behavior

A majority of parents in this study (74%) expressed varying degrees of math anxiety from mild to intense, with nearly half of parents feeling seriously or intensely anxious when confronted with math-related activity. These feelings significantly correlated with parent perceptions of low math skills and knowledge. In addition, several parents with more extreme levels of math anxiety expressed concern over "passing" their anxiety to their children—a concern that is justified, as intergenerational effects of math anxiety have been documented in the literature (Herts et al., 2019; Levine, Gibson, & Berkowitz, 2019).

A more pressing concern is that math anxious parents are less effective in supporting their children's math development (Herts et al., 2019; Berkowitz et al., 2015). Several studies have found that shared math activity involving math anxious parents can negatively impact children's math achievement (Eason et al., 2017; Herts et al., 2019; Maloney et al., 2015).

Other studies have pointed to relationships between parents' negative feelings about mathematics, math anxiety, and lower math expectations for children (e.g., Levine, Gibson, & Berkowitz, 2019; Rozek et al., 2017). The high prevalence of math anxiety among the parents in this study, and the seeming preference of parents for the simple and varied number approaches may hint at this relationship. Parents may feel more confident when engaging in simpler activities, and hesitant or uncomfortable when exploring more advanced concepts that may provoke anxiety. This leads to lower expectations for children in terms of what math concepts and skill parents expose them to.

Limitations

Several limitations exist for this study. The small sample size limits the strength of the correlations and makes it difficult to generalize to the broader population. *Volunteer bias* may also be a factor, given that parents who are more likely to volunteer may over-represent parents who are more involved in their children's educational development in general. *Social desirability* bias is also a concern when examining parents' perceptions of their parenting beliefs, values, and practices. Parents want to portray themselves as "good parents," and may not be forthcoming if doing so might result in them being judged. Lastly, all parents in this study were *geographically homogenous,* hailing from the greater Los Angeles area of California in the United States. It is possible that parents from other geographical areas might show different patterns of perceptions across the five RESET domains.

Areas for Future Research

The data gathered here will be instrumental in guiding the development of a new, more robust, RESET survey. The interview provided an abundance of qualitative that can be

used to inform more specific questions and items on a revised RESET survey that can capture information at scale. As such, an area for future research would be to use a revised RESET survey with a much larger sample of parents ($n > 500$). Doing so might further illuminate patterns within subgroups of parents, empowering the design of parent engagement programs that are better aligned with parents' individual needs and contexts. The more we understand the commonalities and differences in and among parent subgroups, the better we can plan for specific use cases, allowing for more diverse, adaptable, and personalized parent engagement programs. Further areas of research include using the RESET Framework to examine support mechanisms between early childhood teachers and parents (e.g., do parents' RESET perceptions change as a result of intervention?), and to explore how the RESET Framework can be applied in other parent support programs.

Conclusion

The findings of this study suggest that stakeholders should consider designing parent engagement programs that (1) capitalize on parent eagerness to be involved and play an active role in their child's math development, (2) make the most of parents limited time and energy, and (3) account for the likelihood of low parent math skills, efficacy, and the presence of math anxiety. A possible approach that stakeholders might take would be to provide program features that help parents develop an understanding of the critical competencies of early childhood mathematics, as well as easy-to-implement, everyday strategies that parents can use to help their children develop those competencies while building positive emotional connections to mathematics.

The present study has contributed to the body of literature on the HNE in a number of ways. The use of the RESET Framework has illuminated complex relationships between key factors that influence parents' perceptions and behaviors related to supporting the math development of their young children. Findings from this study confirm several findings of previous research such as parents' uncertainty around early childhood mathematics, their desire for more guidance and activities that fit naturally within their lives, and the influence of low parent math skills and math anxiety on parenting practices. However, the RESET Framework helps to push our understanding beyond individual findings to consider how these findings work together in tandem.

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