Math Out of School: Families' Math Game Playing at Home

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Abstract

This study investigated the potential of an approach to involving families in regular integration of math into home life, addressing the following: When families are given math-related games unconnected with children's school, does what parents believe impact the extent to which their families play the games, and how do parents describe their family's learning with the games? We distributed games integrating math and U.S. geography to 30 parents with children aged 7 to 13. Over four months, we followed the extent and nature of families' playing of the games. Families with children under 10 were more likely to continue playing over time; parent education and occupation did not relate to extent of play. Parents described a rich, shared educational experience that they and their children shaped to their interests and interaction styles; some drew a sharp contrast with homework. Although all parents believed the games promoted learning, only one related this learning to potential benefit in school. In light of parents' stated distinction between educational game playing at home and homework, we conclude by considering ways to establish and investigate the impact of a culture of families' engaging in math-related activities for fun at home.

Key Words: math, families, games, home learning, parent involvement

Background: The Need for New Ways to Involve Parents in Children's Math Learning

Benefits and Challenges of Involving Parents in Children's Math Learning

School-age children stand to benefit when parents support their math learning at home: children may be more likely to achieve academic success, to have positive attitudes about learning, and to acquire new skills (Chavkin, 1993; "Engaging Parents," 1998; Epstein, 1994; Henderson & Berla, 1994; Shumow, 1998). Programs at national, state, and local levels have been instituted to promote parental involvement in children's math learning (e.g., www.math.arizona.edu/~mapps, www.dimacs.rutgers.edu/fans, www.lhs.berkeley.edu/equals/FMnetwork.html). Homework and home-school connections are often the focus, encouraging parents to make sure homework is completed, to recognize when and how to help, to engage children in activities that reinforce school learning, and to use homework as a way of learning about school content, pedagogy, and standards. (Note: "Parents" is used throughout this article to refer to those responsible for children's upbringing at home, which may include grandparents or other guardians.)

Parents' schedules and circumstances are not always congruent with the demands of such programs. Classes and school- or community-based events can be very beneficial for those who have access to them and the time to attend. However, at all levels of the parental economic and educational spectrum, the competing demands of work, chores, and childcare pose obstacles for attending programs and events (Hewlett & West, 1998).

Additionally, not all parents seek further involvement in school-related issues. Some parents, such as those who had limited or negative school experiences or who are learning English, avoid school-related events or are hesitant to seek help from schools (Delpit, 1995). Many working parents express the desire for the limited time they have with their children to be focused on the social and emotional side of family life, rather than on homework (Kralovec, 2000; Public Agenda, 1999). Increasing numbers of children complete their homework at after-school programs, rather than at home, and the majority of those who do their homework at home are regularly in conflict with their parents over when and how to complete it. Such conflicts are often exacerbated in math, an area in which many adults feel insecure, and in which current content and pedagogy is sometimes quite different than what parents experienced in school (Ma, 1999; NCTM, 2000; NRC, 2001).

Disconnecting Parent-Child Math Games from Homework and School

The present study was conducted as part of a broader effort to explore alternative approaches to involving parents in their children's math learning. One goal of this broader effort was to create, distribute, and research math-related materials that, unlike required homework, parents and children would *freely choose* to do together. In effect, we sought to investigate the potential of creating cultural change: fun and educational math-related games that would compete for family time.

From the outset, we decided to embed the games in a non-mathematical context to enhance potential for broad appeal. Although the majority of parents view math learning as vital to children's future success, many, especially mothers, lack confidence and enthusiasm in this area (Brew, 2000; Civil, 2001). We reasoned that while families may be unlikely to choose math games to play for fun, they might choose to play U.S. geography games. At the time of the game inception, early 2001, many state coin-related products and associated geography games were available commercially, and we believed that popular interest in U.S. geography was growing. Additionally, the media was beginning to spotlight Americans' (lack of) knowledge in this area. For instance, studies at the time showed that 34% of American fourth graders were not able to write down the name of their home state and find it on a U.S. map (Hoff, 2002); 70% of American 18- to 24-year-olds could not locate New Jersey on a U.S. map, and 49% could not find New York state (cnn.com, 2002, ¶ 11).

Game development involved several rounds of formative testing and revision. The final materials, *USA by the Numbers*, consists of five games based on a deck of 50 cards. Each card displays a satellite image of a U.S. state and numerical and qualitative data about the states. Figure 1 shows a sample state card. In addition to the cards, each game box includes a large satellite map of the U.S., a booklet of game directions, and graphical and tabular summaries of the data on the cards.

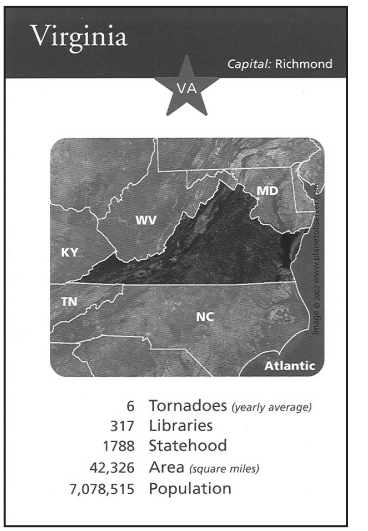

Figure 1. State Card

Features of Games Used in the Study

In designing the games, we incorporated several features intended to enhance the chance that parents and children would choose to play.

Accessibility and Visual Design

We sought to create games that the majority of English-speaking U.S. working parents could use without an introductory workshop. Complex activities and pages of instructions can preclude engagement for busy parents, regardless of background. When developing the games, we conducted formative testing with parents of a variety of education levels from pre-GED to graduate degrees, and we only included games that could be described simply and briefly.

If families don't find the games a fun or valuable use of their time, they won't choose to play (Solomon, 2003). To increase the likelihood that most families would find something compelling in *USA by the Numbers*, we included a variety of game formats. For instance, the basic games are competitive, but all have a cooperative variation; some games are fast-paced, and others require planning and strategy on each turn. To provide a visually appealing alternative to commercial games, we engaged a graphics firm with expertise in family materials to design the text layout, graphics, and game box.

Opportunities for Engagement Over Time

The games offer opportunities for multiple levels of challenge, so that children will not quickly outgrow them. For instance, consider the instructions for "Guess My State," similar to "Twenty Questions:"

> At the start of the game, one player lays out the state cards and silently chooses a "secret" state. On successive turns, the other players try to determine the secret state by asking yes-or-no questions. For instance, if a player asks, "Did the secret state join the union after 1812?" and the answer is "yes," the player removes all the states that joined in 1812 or earlier. The states remaining are those that joined after 1812. Players continue asking yes-or-no questions and eliminating cards until only the secret state remains.

Figure 2 summarizes learning opportunities with this game. Level of difficulty can be adjusted by choice of data categories: for less challenge, players can ask questions based on qualitative data (e.g., existence of an ocean border) and numerical data with small numbers (e.g., average annual number of tornadoes); for more challenge, they can ask about categories involving larger numbers (e.g., population) or derive composite categories such as population per square mile. As players gain expertise, they develop more efficient strategies, in this case, finding questions that rule out more cards.

Figure 2. Content in Guess My State

Math skills	Reading and comparing numbers up to the millions (e.g., 1845 is after 1812)
Geography skills	State facts (e.g., capitals, bordering an ocean) and locations
Logic	Reasoning about questions that will rule out the most cards, and deciding which cards to eliminate based on the answers
Geography concepts	Regional patterns (e.g., tornado concentrations, relative size of Eastern vs. Western states) and relationships among state features (e.g., tornado density vs. absolute number of tornadoes)

Opportunities for Parents to Support Children's Learning

Although many parents are not eager to do homework with their children, the great majority of parents view learning basic skills as an educational priority for their children (Peressini & Adajian, 2001; Public Agenda, 1995). Thus, we designed the games to offer opportunities for working with basic skills in math and geography. We also included opportunities for players to explore conceptual material consistent with recent national standards in math and geography (NCGE, 1994; NCTM, 2000). Such content (e.g., logic, relationships between state region and date of statehood), likely to be less familiar, could provide a basis for parents and children to learn together.

Although we intentionally embedded content that we anticipated parents would be able to draw out and share with their children, we did not prescribe an approach to doing so, reasoning that parents are already familiar with scaffolding everyday activities for their children (Rogoff, 2003).

Subjects and Method

Subjects

We recruited 30 parents with at least one child between the ages of 7 and 13 through advertisements in Boston-area community newspapers and on public notice boards: "A non-profit company seeks parents and 7-13-year-olds for study of math/geography games. Fathers welcome." Our sample included nearly equal numbers of fathers and mothers: 13 (43%) and 17 (57%), respectively. All parents who participated were initially unfamiliar with the games. Parent education ranged from high school completion to doctoral degree, with the majority having completed college:

Table 1. Parents' Education

	N (total = 30)	%
High school	3	10%
Some college	6	20%
College	10	33%
Masters	9	30%
Doctorate	2	7%

Of the 30 parents, 23 had just one child participating in the study, 4 parents had 2 participating children, and 3 parents had 3, for a total of 40 children.

Table 2. Children's Ages at Time of First Interview

	N	%		N	%
7 years old	7	17.5%	11 years old	7	17.5%
8 years old	9	22.5%	12 years old	6	15.0%
9 years old	2	5.0%	13 years old	5	12.5%
10 years old	4	10.0%			

Method

Introductory Session

Each parent-child pair/group came to our office for a 45 to 60 minute individual or small-group session in which a project staff member introduced the game Guess My State and, in most instances, one or two of the other games. Game introduction took only a few minutes. After that, parent and child continued playing, and the staff member took notes. At the end of the session, we gave each family a set of the games and asked them to play at home for as little or as much time as they wished before a follow-up phone interview. (See Appendix for interview protocols.)

First Interview

We interviewed each of the 30 parents by phone 7to16 days after the introductory session, with an average of 9 days intervening. Average interview time was about 30 minutes. When parents completed the interview, they were paid for their time.

Second Interview

Two to three months after the first interview, we sent parents a letter inviting them to call us to arrange a second phone interview, for which they would be paid. We encouraged them to call *whether or not they had used the games* in the intervening months. Of the 30 parents, 22 (73%) called us, and all who called completed a second interview. These parents had a similar profile to the larger group. On average, the second interview was conducted 3.5 months after the first. Average interview time was about 20 minutes. It should be noted that we have no information whether or not the eight parents who did not call continued playing the games. In two instances, our letters were returned marked "addressee unknown."

Data Recording and Analysis

The interviews covered the topics described in the Appendix. The interviewer recorded the conversation by typing as parents spoke. The same staff member conducted all but two of the interviews. Two staff members analyzed

the data, developing a coding scheme through successive iterations of reading through transcripts to find commonalities in responses, creating classification criteria, and making and then comparing classifications to ensure agreement. This process continued until they were in agreement about all classifications.

Data Reporting

We report family background (parent gender, parent education, children's age, parent employment status) *only in the two instances in which they appear relevant*. In all other instances, the demographic profile of the group of parents who responded in a particular way was similar to that of the larger group. In all reporting of children's ages, we use age at the time of the first interview.

Results

We present results in four sections. The first involves the extent to which families chose to play the games; the second and third to family learning – parent perceptions of learning and parent teaching, respectively; the final section reviews parent comments on aspects of the games that their families found most valuable.

Results: Extent of Game Use

How Often Did Families Play?

As we requested, all families tried the games at home before the first interview, with 60% playing more than twice. During the period between Interviews 1 and 2, we did not ask families to play, but about two-thirds chose to do so. Instances of game play in the table below consist of the number of times someone in the family reported using the games, regardless of amount of time spent playing or number of games per use.

Table 3. Frequency of Play

	Interview 1		Interview 2	
Times played	**N (total = 30)**	**%**	**N (total = 22)**	**%**
0 times	0	0%	7	32%
Some play reported	30	100%	15	68%
1-2 times	12	40%	4	18%
3-4 times	11	37%	2	9%
5-6 times	4	13%	4	18%
7 or more times	3	10%	5	23%

In both interviews, parents reported an average playing time of 40 minutes per use of the games, with a mode of 30 minutes and a range of 15 minutes to 2½ hours. Duration of play sessions was unrelated to frequency of play.

What Reasons Did Parents Cite for Their Extent of Play Over Time?

In the first interview, parents attributed frequency of play to circumstances of the period before the interview. For instance, some were away on business trips much of this time; others were on vacation at home with their children. In the second interview, all parents described extent of game playing as a family or child's choice, rather than parental directive. Families' reasons for extent of play in the second interview fell into three categories:

Parents reporting maximal play (5 or more times). These parents (41% of those completing the second interview) attributed frequency to the games becoming integrated into family routines, such as regular family game nights, car trips, or weekend activities.

Several parents described their families as frequent game players who incorporated *USA by the Numbers* into their game repertoire: "We play [games] about twice a week after dinner. We have Monopoly, Sorry, card games, these games [*USA by the Numbers*], and Scrabble." [P3, parent of 8-year-old] "Any game he likes. We play games all the time." [P22, parent of 7-year-old]

A parent who formerly homeschooled her child incorporated the games into the family game repertoire, but emphasized that the educational component of the games provided added incentive to play. This parent was *the only one throughout both interviews* who suggested that playing the games might improve school performance, saying "I'm big on education and I thought this was a good way to reinforce the state information for school, so when they're doing the states he'll know more about it." [P7, parent of 8-year-old]

One mother, a single parent, works at a job that requires extensive, regular automobile travel. Her son accompanies her on these trips. They have adapted the games so that they can play during their regular travel:

> We travel from city to city in America by car, and we always use this…I say, "Who has the most libraries?" and he tells me. He plays [*USA by the Numbers*] games with his friends, but when we drive we always keep the cards in the back. He plays the game, Guess My State [in the car]. [P10, parent of 8-year-old]

In two families, the games became a habitual weekend activity. One said:

> [My children] play two to three games [from *USA by the Numbers*] each weekend, not usually during the week. Either [one or the other of the children] wants to play and gets the other to play. [P21, parent of 11-year-old and a child younger than study participants]

Parents reporting moderate or minimal play (between 1 and 4 times). These parents (27% of those completing the second interview) attributed frequency to the fact children didn't choose to play the games or that the family likes other activities: "We don't do board games a lot…[but] it's a change from reading, which is most of what we do when we're indoors." [P2, parent of 8-year-old] "I asked them why they didn't play more. They don't know. No particular reason." [P27, parent of 8- and 10-year-old]

Several parents also mentioned that the game had been put away, although one pointed out that had it been a favorite, children would have requested it: "It would only occur to them [to play] if they saw it laying on the dining room table. It didn't make the impact that they would ask for it." [P23, parent of 7- and 10-year-old] "We kept forgetting where we put it. It goes in a pile with the other games." [P12, parent of 9-year-old] "Games go in the closet and don't get resurrected unless someone thinks of it." [P24, parent of 7- and 10-year-old]

Parents reporting no play. These parents (32% of those completing the second interview) cited reasons related to children's age or grade, including homework, extracurricular and social activities, and disinterest in playing games with parents: "She has a demanding schedule. They load you down. Outside the classroom activities keep her busy four nights a week." [P9, parent of 12-year-old] "He's 13, going to be 14 in a month, so he doesn't really hang out with his parents much." [P17, parent of 13-year-old]

A couple of parents with multiple children noted that no one played because one of the children felt too old: "It was too young for my 12-year-old, and my 10-year-old…had fun with the game but her older brother was too old to play." [P14, parent of 10- and 12-year-old]

What Role Did Family Factors Play in Game Use?

Continued game play over time was related to only one family factor: age of child. As Table 4 shows, *all* families with a child 7, 8, or 9 continued to play. Half of those with children 10-13 continued playing, with an age-related decrease in play: 71% of children 10 and 11 played, and 25% of those 12 and 13 played. Average age of those who played was 8.90; average age of those who did not play was 11.88. Age was unrelated to the number of times played.

Table 4: Children's Game Play Over Time (Reported in Interview 2) by Age

Age	Played		Didn't play	
	# of children	% of age group	# of children	% of age group
7	6	100%	0	0%
8	5	100%	0	0%
9	2	100%	0	0%
10	2	67%	1	33%
11	3	75%	1	25%
12	1	20%	4	80%
13	1	33%	2	67%
Total	20		8	

What Role Did Children Play in Choosing Which Games to Play?

Parents' reports of game playing suggest that they followed children's lead in determining not only whether to play, but also which games to play. Most parents reported playing only the games we introduced them to (57% in the first interview; 73% in the second), with several noting that they had hoped to try new games, but didn't in order to follow children's interests: "When my kids want to play, they want to PLAY. They don't want to learn something new when they want to play." [P4, parent of 13-, 11-, and 8-year-old] "My idea was to…play all the games. [My child] really liked Guess My State, but after he played Take a Trip, he got into that one [and that's all we played]." [P13, parent of 7-year-old]

The majority of those who went beyond the games we introduced them to learned only one game on their own. Those who tried new games appeared to have understood the directions, as indicated by their descriptions of game play. Trying new games was unrelated to family factors or to frequency or length of play sessions.

Results: Learning Over Time

In Interview 1, we asked parents their views on children's learning with the games; in Interview 2, we asked just those families reporting game play. To allow for comparisons, the analyses in this section and the next are based on parents' comments on learning with Guess My State, since all families played this game.

What, If Anything, Did Parents Believe Children Learned from Playing?

In both interviews, all parents reported that their children learned from playing, with most reporting learning in multiple areas. We classified parent responses according to four categories as described in Figure 2 above.

Table 5. Children's Learning by Content Area

	Interview 1		Interview 2	
	N	%	N	%
Total parents reporting learning	30	100%	15	100%
--geography skills	29	97%	12	86%
--math skills	21	70%	6	43%
--logic	13	43%	3	21%
--geography concepts	12	40%	4	29%

Below is a summary of the nature of responses to each of our three content prompts (see Appendix) used during interviews and classification:

What if any math did your child/ren learn? In response to this prompt, parents mentioned reading numbers and/or place value, corresponding to our math skills categorization: "He learned place value…even though the 7 digit [number] began with a 1 and the 6 digit [began with] a 6, the 7 digit was

larger." [P15, parent of 8-year-old] "To learn to state something like '500 *or more*' instead of '*over* 500.' That little subtle, when you draw the line, where exactly are you drawing the line?" [P6, parent of 8-year-old] Another said:

> He knew the term "millions" because dinosaurs lived 65 million years ago, but he didn't know how to write that [until he played]. This game is the first time that he ever saw the numbers written out into millions. [P22, parent of 7-year-old]

Several parents noted that their children did not learn any new math from playing because they already knew the material. Reports of children already knowing the math was unrelated to children's age. "Math, we're still learning our commas [in numbers], but that's a kid for you." [P27, parent of 12-year-old] "I don't know if he really learned anything. You *can* learn, if you're looking at…more than, less than. He already knew all of that. It involves math, but he didn't learn anything." [P8, parent of 8-year-old]

Two parents mentioned content that we classified as math skills, but they questioned whether children actually learned math since they did no computation: "When you say math I think adding and subtracting and figuring it out. It wasn't conducive to that. But millions, that was real good." [P5, parent of 12-year-old] "You could just tell if it was a few million more or less, so there wasn't math.…There was no multiplication and division." [P12, parent of 9-year-old]

What if any geography did your child/ren learn? Unlike math, geography content was salient to all parents, and all parents reported geography learning. Nearly all mentioned geography skills, such as state locations, capitals, names, and other facts. "Learning the locations of what states are where and what they border, whether they're near large bodies of water and what those are, whether they border Canada." [P24, parent of 7- and 10-year-old] "She loved the tornadoes – we were all interested in that. Where the states were – she has a pretty good sense of geography [so that wasn't new] – but she learned the area of the states, the population, the facts." [P9, parent of 12-year-old]

Some also discussed geography concepts, such as regional patterns and relationships among state features: "She picked up a few things about the fact that you don't get tornadoes on the coast, also the relative size of the different things." [P9, parent of 12-year-old] "Population density. Some of the bigger land masses and what their population is, and smaller ones and what their population is. You have population and area on the cards, so population density is right there, and she started noticing it." [P11, parent of 12-year-old]

Did child/ren learn anything else? In response to this prompt, several gave answers that we classified as logical thinking; others who had a response talked more about children's geography or math learning, and we classified their responses accordingly.

> They really got a better handle on how to interpret questions like "are there more than this happening," and then use the answer yes or no to figure out what to do, what to remove. [P25, parent of 13-, 11-, and 8-year-old]

> The process when you get to the end of the game and you're approaching the choosing which state and you have to figure out which questions are the best questions to ask based on the numbers so you'll cut out the most cards. [P13, parent of 7-year-old]

Only one parent mentioned logical thinking when asked about math learning, although logic is considered a component of math (e.g., NCTM, 2000).

In discussing children's learning, a few parents reflected on the synergy among content areas, including ways in which developing math skills increased access to geographical information and ways in which interest in one content area whetted interest in others. "It wasn't just memorizing facts, but you had to look at the facts and try to determine – if it's this one it can't be that one, the whole logic aspect." [P7, parent of 8-year-old] "I thought that combining something that's a big passion – geography – with something he's not as engaged in – math – would help.…The game is a good way to get him using numbers." [P22, parent of 7-year-old] "The year the state became a state – he learned to read the numbers. A lot on the east became states at the same time, and he learned to separate the ones that weren't." [P15, parent of 8-year-old] Yet another parent said,

> As his familiarity with numbers and things grow, you learn a lot about the states in the process of doing a game. Initially, he was getting [how to read the numbers], then he learned about the states.…As we continue to play this, he gets more comfortable with larger numbers…he's getting more interested in population. [P20, parent of 7-year-old]

Results: Parents Supporting Their Children's Learning When Playing

As in the previous section, this analysis is based only on parents' comments about Guess My State.

To What Extent Did Parents Play the Games with Their Children?

To provide a baseline of parent opportunities to support children's learning, we asked who at home actually played the games. The results are shown in Table 6.

Table 6. Who Did Children Play With?

	Interview 1		Interview 2	
	N	%	N	%
Played at least once with parents	**30**	**100%**	**11**	**73%**
Played only when parents present	26	87%	8	53%
Played with parents sometimes; with other sometimes	4	13%	3	20%
Never played with parents	**0**	**0%**	**4**	**27%**

To What Extent Did Parents Report Teaching Their Children When Playing?

Although only four parents used the world "teaching" when describing playing the games with their children, 77% in Interview 1 and 45% in Interview 2 described some sort of instructional behavior. Parent reports of teaching were equally distributed among geography skills, math skills, and logic, with somewhat fewer in geography concepts. Nearly half reported teaching in more than one content area. We counted remarks such as the following as indicative of teaching:

- Directly providing or highlighting information: "I try to push them a little, to make them think.…Like bringing up the letters in the names so she had to look and count the specific numbers of letters in the names." [P24, parent of 7-year-old]
- Explaining their thinking or making observations: "I try not to make too many suggestions or put words in their mouth. But when it's my turn, I'll verbalize, so they know I'm noticing [a certain characteristic of the states]." [P23, parent of 7- and 10-year-old]
- Modeling strategies: "I helped him, so we didn't just ask the same questions. I told him, 'If we were the Simpson's we'd be asking the same thing over and over again.' We had to ask different questions. We played: try to ask the fewest questions.…He mimicked my questions after that." [P17, parent of 13-year-old]

Several parents related their role with the games to regular interactions with their children. For instance, one parent who reported directly instructing her child explained: "I'm a teacher all the time. [My children] say I'm always trying to slither in a fact. I have that attitude when I talk to my kids." [P12, parent of 9-year-old]

By contrast, a parent who taught by verbalizing her thinking also drew connections to parenting style: "I'm learning as I'm a parent how important it is not to be overbearing, to give them space and give them time." [P23, parent of 7- and 10-year-old]

Results: What Did Families Find Most Valuable About the Games?

In Interview 1, we asked parents to identify what their families found particularly valuable about the games; in Interview 2, we asked just those who reported continued game play. In both interviews, the majority of parents mentioned more than one aspect.

Table 7. Parent Reports of Valuable Aspects of the Games

	Interview 1		Interview 2	
Aspect	N (total = 30)	%	N (total = 15)	%
Children's learning	18	60%	8	53%
Family likes games	16	53%	6	40%
Chance to watch children learn	14	47%	6	40%
Parent's learning	13	43%	0	0%
Usability features	10	33%	2	13%
Quality family time	11	37%	3	20%
Makes learning fun	4	13%	4	27%

Children's learning has been discussed in a previous section; below we describe the other aspects that parents mentioned:

Family likes games. Parents describe the family as frequent players: "We're big game players in our house. We are both computer geeks, so we play a lot of computer games. We play board games as well." [P7, parent of 8-year-old]

Chance to watch children learn. Parents mention observing children's picking up new material or watching children's joy in learning: "I didn't know he knows so much…It's nice to see him doing it in front of me. He brought home [the worksheets he did in school], but I didn't see him doing it in school." [P3, parent of 8-year-old]

Parent's geography learning. Parents mentioned their own learning geography skills or concepts when playing: "I learned a few things myself. Iowa. I thought it was closer. Idaho. I thought it was closer, too…How many people fit in that little state?" [P28, parent of 12-year-old]

Usability. Parents noted features of the games that make them especially easy to fit into daily life. These include physical aspects of the materials (e.g., large, readable cards; portability) and game structures (e.g., game brevity).

> The games are short, and you can string them together. There are so many good opportunities for cutting it off, not like Monopoly. I have dinner to make and laundry. She says "Can you play Monopoly with me?" and I say no. With this, I can say yes. But here, you can play for 10 or 15 minutes and you're not cutting out early. [P6, parent of 8-year-old]

Makes learning fun. Parents pointed out that in some instances, children were learning without "knowing" they were doing so. "No way you can make geography fun for most kids. But this game – kids love playing games, they don't even know they're learning, probably." [P9, parent of 12-year-old]

Quality family time. Parents mentioned that the games provided the basis for positive interactions with their children or among the whole family. "There aren't a whole lot of things that a 50-year-old man and his 12-year-old daughter get to do together that they're on a relatively even keel, but this is one." [P9, parent of 12-year-old] "I liked it because they did." [P4, parent of 13-, 11-, and 8-year-old]

What Role Did Family Factors Play in Game Aspects that Parents Valued?

Only one aspect was related to family factors: *Mothers* particularly appreciated game usability. Just over half (9 out of 17) of the participating mothers in Interview 1 cited at least one of these features as an especially valuable aspect of the games; only 1 father out of 13 did so. Both parents who cited usability features in Interview 2 were mothers.

Discussion

What We Learned About Families Who Chose to Play the Games

The games were intentionally designed to provide an appealing and rich educational experience for a broad range of families. However, educational materials are only effective if they are actually used. This study has enabled us to investigate characteristics of families who chose to play and their reasons for playing as much or as little as they did.

Families with Younger Children Were More Likely to Play Over Time

Our initial sample included families with children ranging in age from 7 to 13. At the time of Interview 2, all those with children under 10 were still playing the games, but only half of those with children 10 to 13 were still playing. Those who discontinued play all cited reasons related to children's age or grade. In other respects, families who continued playing varied considerably, including parents with high school education and post-graduate degrees, single parents, recent immigrants with limited English, two-parent professional couples, families with one child, and families with several children.

Families Who Played Most Often Shared Some Characteristics

Frequent players reported having integrated the games into regular activities and routines, such as family game nights and long car rides. Frequent players also included a higher concentration of parents who reported that their families liked playing games.

Accessibility Doesn't Guarantee Use

All of the games proved very accessible: Each took only a couple of minutes to introduce in our introductory session, families seemed to have remembered the directions when at home, and those parents who read directions for games

we had not introduced reported playing them as we had intended. Nonetheless, just because parents are able to read the directions doesn't mean they will. Many families throughout the educational spectrum only played the games that we introduced; once they were comfortable with a couple of games, they often didn't make the effort – however minimal – to learn others. Furthermore, several parents reported interest in trying out new games, but did not do so because children requested that they stick with the familiar ones.

Usability Matters, Especially to Mothers

All parents mentioned aligning game playing with family schedules, interests, and personalities. Mothers, typically responsible for the bulk of household chores and childcare even when working full-time (Crittenden, 2001), particularly valued the "usability" features of the games, such as game portability, brevity of individual games, and formats that enable play by different ages.

What We Learned About Family Learning with the Games

Parents Recognized and Valued Learning with the Games

All parents thought their children learned from playing the games; those reporting play in the second interview found that the games had not exhausted their potential as educational tools. Although the majority noted learning in the more traditional areas of geography skills and math skills, many also believed that children learned logic and geography concepts. Parents viewed learning opportunities as among the most valuable aspects of playing: In both interviews, children's learning was most often valued, followed closely by family enjoyment of games and opportunity to observe children as they learned.

Parents Did Not Relate Learning to School

Given parents' widespread valuing of children's learning with the games, it is striking that only one parent related game play to the possibility of improved school performance. Instead, parents appeared to consider the game content intrinsically worth learning. Their comments suggest they viewed the materials as containing a wealth of possibilities for learning in multiple domains.

Parents and Children Jointly Constructed the Educational Agenda – In Contrast to Parent-Child Homework Interactions

Parents described letting children play a substantial role in deciding what, when, and how much to play; they also reported shaping the games to meet children's growing skills and interests. This stands in sharp contrast to the roles parents may play in supporting children's learning during homework time, often beset with conflict and stress. Several parents pointed out that when parent and child jointly construct the educational agenda, the tone and timetable can differ markedly from joint homework completion. One parent explained:

> When we're doing math [homework] and my daughter starts squirming around, and I say "will you sit down, we need to get this done," my daughter is passive-aggressive and it aggravates me. But now, we don't have any of that when we're playing the games.…It's different than doing homework, or a project, where it can get stressful. We have a deadline [for homework], when I'm helping my daughter, and we're fitting it into MY schedule, which isn't always her schedule. She wants to watch a TV program, she wants to go somewhere…[with the games] I'd try to help her…learn to ask more logical, better questions. It's relaxed, it's fun, no stress, which I'm sure is the point of the game, to make learning fun. [P30, parent of 12-year-old]

All Parents Readily Supported Their Children's Learning

Although parents varied in how they supported their children's learning, none reported having difficulty doing so. All who reported teaching appeared to have a clear sense of if, when, and how to help their children, whether the material was familiar (e.g., numbers, state names) or whether they were sharing what they themselves were learning as they played (e.g., state relationships, effective game-playing strategies). Several explicitly related ways they helped their children with the games to ways they regularly interacted with their children. Previous research (Anderson, 1997; Anderson et al., 2004; Young-Loveridge, 1989) has demonstrated parents' strategies for supporting their preschool children's math learning; the present study suggests that parents have some resources for supporting the math learning of their school-age children as well.

Emerging Questions

What Are Effective Methods of Distributing Educational Materials for Use at Home?

Findings from the present study resonate with previous research on math activities for families (Kliman et al., 2000) suggesting that even with very accessible, appealing, and well-designed materials, distribution that includes a brief orientation can greatly enhance likelihood of use at home. Yet, as noted before, many parents are not able or willing to attend any sort of orientation, no matter how brief. The approach taken in this study – bringing parents to an office to distribute games – is impractical on a large scale. Below we consider three potential arenas for distribution, all of which merit further investigation.

School distribution. Even if parents don't attend school events, children can become familiar with the materials and then take them home to use with their parents. However, throughout the interviews, many parents made sharp distinctions between materials freely chosen for fun at home (no matter how

educational) and school assignments: the former involving positive parent-child interactions, a jointly constructed educational agenda, and a sense of parental freedom and competence in adapting materials for their family; the latter characterized by stress, rigidity, and prescribed roles and timetables. Further research should explore the feasibility of school distribution in ways that retain a positive tenor and enthusiasm about learning. More generally, research should explore whether a closer tie to school would further motivate parent-child game play, or whether, on the contrary, it would detract from the appeal of the games.

After-school distribution. Millions of children and youth regularly attend after-school programs, and demand for such programs is growing (NIOST, 2005). For reasons of culture, language, community, and educational background, many parents find their children's after-school environments more comfortable and welcoming than school. Discontinuities between home/community and school cultures are substantially mitigated in after-school settings (Noam et al., 2003): Unlike in public school, where 90% of teachers are white (Keller & Manzo, 2003), after-school staff typically reflect the diversity of the enrolled students and their parents, and many staff have strong community ties. Furthermore, some working parents have significantly more contact with after-school teachers and knowledge of children's after-school learning, as work schedules may preclude school communication and involvement (Miller, 2003).

In addition to providing a regular conduit for parent communication, after-school programs can serve as a basis for introducing a variety of materials and offering support on an ongoing basis: Children can learn the games, bring them home, and then teach them to their families. Potential of this approach was explored in a pilot study involving several 5th and 6th grade students enrolled in an after-school program. The children learned math-related games in their programs, and then brought them home and introduced them to their families. Two weeks later, an after-school staff member spoke with parents at afternoon pick-up time to learn about extent of game use at home and to encourage further use. The majority of parents indicated that their families had continued playing the games at home. In subsequent weeks, the staff member occasionally asked about continued game play when she chatted with parents at pick-up times; these brief conversations about the games appeared to have supported continued interest in playing at home (Kliman, 2003).

Science center and community center distribution. Many science centers and community education venues offer regular programs to support family education, after-school programs, and community services. Some of these, such as the Saint Louis Science Center, focus on engaging low-income families of color. Although the challenges of reaching parents unable or unwilling to come

to any parent-child events remain, community-sponsored events also have the potential to reach a broad range of families who, for reasons of culture, language, or background, may feel uncomfortable attending events at school.

What About Families Who Don't Play Games Together?

The role of children's age in the present study resonates with results from research in parent-child reading and homework (Public Agenda, 1999), which show parent participation declining in the middle elementary grades. Although programs have been designed to engage parents and their middle grade children in doing math together (Thompson & Mayfield-Ingram, 1998; www.figurethis.org), we know of no studies that investigate the extent to which parents and children actually *do* the activities at home over time. Research is needed on effective ways to engage families with middle grade children doing math together at home – and indeed, the extent to which any parent-child math activities are likely to be appealing to this age range.

Among those who played the games most frequently, the majority of parents described their families as enjoying games; interest in parent-child board games is not universal. Encouraging families to play games when they in fact prefer to spend time doing other family activities may not ultimately be successful. If math-related activities are to become part of family culture – what families choose to do at home – multiple approaches to math at home are required. Research is needed to investigate a variety of math-related activities that families view as engaging and valuable ways to spend time together.

What Is the Longer-Term Impact on Math Learning at Home?

There is widespread awareness that parents, by offering encouragement, enthusiasm, and support, can play a vital role in children's learning. Parental support and positive family experiences can promote learning in math even when improved school performance is not the goal. For instance, family activities involving the math of actual shopping and money exchanges can contribute to academic achievement when carried out as part of everyday life, rather than as an academic support activity (Guberman, 2004).

If math-related games can serve as an arena for positive family experiences, they have potential to make an impact on children's attitudes and interests over time. Additional research in this area should address two related themes. First, what factors contribute to family engagement in math-related activities at home? For instance, can positive experiences with a particular set of games serve as a springboard for engaging in other math-related activities? To what extent does ongoing support from others – community workers, after-school staff, or teachers – have an impact on continued experiences with math-related activities? Second, in what ways can various sorts of informal math activities

with parents at home impact children's attitude toward and performance in related school subjects? This should address both particular skills that the informal activities address, and more broadly, engagement and interest in math-related topics, school subjects, and careers.

Conclusion

Parents described the game playing as a rich, shared educational experience that they and their children shaped to their own interests and family interaction styles. Although children's learning with the games was important to parents, learning was not their only reason for playing. They also valued the fun of playing games together, the chance to observe children learning, and aspects of the games that rendered them easy to use in the course of daily life.

All parents believed that children learned from playing the games, and many were enthusiastic about observing and participating in children's learning – even though they did not relate this learning to school. While engaging parents in their children's school math is undeniably worthwhile, the present study suggests that engaging families in math unrelated to school has potential as an alternative route to promoting positive experiences with math and shared learning between parents and their elementary school-age children.

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Appendix: Topics Forming the Basis for Interviews 1 and 2

Interviews covered the questions below, with the interviewer making individual adaptations in format and sequence in order to establish rapport with parents and to follow the flow of each parent's conversation. Although we prefaced our questioning with assurance that we were just as interested in what didn't work well when families played the games as what did, we felt that maintaining a friendly, conversational tone throughout helped to promote an atmosphere in which parents felt comfortable giving honest and detailed responses.

The first interview addressed the following topics:

(1) Attitudes and experiences of math and geography learning: children's school math and US geography experiences, parents' views on children's learning in these areas, parents' own experiences as school children.

(2) Circumstances of game play at home: who played, how often and for how long they played, which games they played, when during the day they tended to play, parent-child interactions during play.

(3) Learning: What, if any, math and geography children learned; what, if any, other things children learned.

(4) Most valuable aspects of the games: What was most valuable about the games.

(5) Anything else parents want to mention about the games.

The second interview addressed the following:

If families did not use the games: We explained that we are interested in why some people don't keep playing the games and asked parents to tell us their reasons for discontinuing game play.

If families used the games: We addressed the topics listed under (2) through (5), above, with the exception of parent-child interactions during play.