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RESEARCH IN MATHEMATICS EDUCATION

Spatial Reasoning: Home Environment Questionnaire Phase 1

Technical Report 20-09

Spatial Reasoning: Home Environment Questionnaire Phase 1

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Abstract

The Spatial Reasoning Home Environment Questionnaire was created as a component of the Measuring Early Mathematics Reasoning Skills (Project MMaRS) funded by the National Science Foundation's Discovery Research Pre-K-12 Program. We developed the questionnaire based on previous literature and distributed it to the parents of 55 children across two schools. Results from the questionnaire provided a better understanding of students' exposure to spatial reasoning activities outside of school.

Table of Contents

Spatial Reasoning: Home Environment Questionnaire Phase 1

Introduction

The Measuring Mathematics Reasoning Skills (MMaRS) project, funded by the National Science Foundations, was tasked with creating assessments of students' numerical and spatial reasoning skills for students in grades kindergarten, first, and second. We developed learning progressions that outline our hypothesis of how students learn in both domains. To provide more information about possible influences within the spatial domain, we developed a home environment questionnaire to better understand students' access to different spatial manipulatives (e.g., maps, blocks) and their parent's/guardian's level of engagement with their child with spatial reasoning activities. We hypothesize that these factors may influence students' ability to reason spatially.

Purpose

The purpose of the questionnaire was to understand students' exposure to spatial reasoning activities outside of the school setting. We asked parents about the spatial activities their children engage in at home. Specifically, the frequency with which they engage in these activities and their engagement with their child in spatial activities. We proposed the following research questions:

- To what extent do students engage in spatial reasoning activities at home?
- To what extent do parents/guardians engage in spatial activities with their children?

Method

In this section we explain the development and analysis process for the home environment questionnaire. In particular, we highlight the review of literature and the development of items.

Literature Review

We first reviewed the literature and searched for articles pertaining to early mathematics (i.e., pre-school through grade 2). Specifically, literature investigating parents' use of spatial relations activities with their children. We were interested in research on spatial activities that parents were engaging in with their children at home, and children's access to certain materials in the home that are linked to spatial awareness. Previous literature investigated ideas and concepts that were tangential (e.g., mix of spatial and numeric relational reasoning) to spatial awareness and its connections to the home environment. We utilized these articles to create survey questions based on similar surveys mentioned in the research. The research team modified all items to align with the purpose of the MMaRS research project. The following 11 sources were utilized because they looked at mathematics environments in the home:

1. Zippert, E. L., & Rittle-Johnson, B. (2018). The home math environment: More than numeracy. *Early Childhood Research Quarterly*, 50, 4-15.

   This article was about a survey study that researchers administered to parents of preschool aged children gauging their knowledge about numeracy, spatial, and pattern components of early mathematics in addition to their beliefs about mathematics. The preschool children were administered a mathematics assessment and parents' support relate to children's skills.

2. Napoli, A. R., & Purpura, D. J. (2018). The home literacy and numeracy environment in preschool: Cross-domain relations of parent-child practices and child outcomes. *Journal of Experimental Child Psychology*, 166, 581-603.

   This publication described a study with preschoolers and their parents looking at the home numeracy and literacy environment and its effects on numeracy and literacy skills and language development. Researchers considered how book reading and numeracy scores were related, and also literacy outcomes and their connection to the home numeracy environment.

3. Ho, A., Lee, J., Wood, E., Kassies, S., Heinbuch, C. (2018). Tap, swipe, and build: Parental spatial input during iPad and toy play. *Inf Child Dev.*, 27, 1-16.

   This study described the observations of the use of spatial talk between preschool aged children and their parents using either puzzles and blocks or iPad apps. Researchers examined the difference in use of spatial talk between these two modes of play-based interactions.

4. Ferrara, K., Hirsch-Pasek, K., Newcombe, N. S., Golinkoff, R. M., Lam, W. S. (2011). Block Talk: Spatial Language During Block Play. *Mind, Brain, and Education*. 5, 143-151.

   This article was about the language used in adult-child interactions during spatial play situations. Researchers observed language expressed during free play with blocks, guided play, and play with preassembled structures. Findings included that block play contributes to increased use of spatial language compared to other types of play.

5. Verdine, B. N., Golinkoff, R. M., Hirsch-Pasek, K., Newcombe, N. S., Filipowicz, A. T., Chang, A. (2014). Deconstructing Building Blocks: Preschoolers' Spatial Assembly Performance Relates to Early Mathematical Skills. *Child Development*. 85, 3, 1062-1076.

   This publication described a three-pronged study analyzing how three-year-olds assembled interlocking blocks when presented an assembled model. They compared the spatial construction ability to mathematical performance and examined spatial construction skills with family demographics and use of spatial language in the home.

6. Levine, S. C., Ratliff, K. R., Huttenlocher, J., Cannon, J. (2011). Early Puzzle Play: A Predictor of Preschoolers' Spatial Transformation Skill. *Developmental Psychology*. 48, 2, 530-542.

This study considered the link between children playing with puzzles, and their spatial skills. Pre-school aged children who were observed playing with puzzles with their parents performed better on a mental transformation task.

7. Pruden, S. M., Levine, S. C., Huttenlocher, J. (2011). Children's spatial thinking: does talk about the spatial world matter? *Developmental Science*. 14:6, 1417-1430.

   This study described a longitudinal investigation in which researchers were interested in the use of spatial language between pre-school aged children and their parents. Additionally, the children were given three, non- verbal spatial assessments and their performance was compared to their use of spatial language.

8. Pruden, S. M., Levine, S. C. (2017). Parents' Spatial Language Mediates a Sex Difference in Preschoolers' Spatial-Language Use. *Psychological Science*. 28(11), 1583-1596.

   This article was about a study examining differences in children's spatial language use by sex. Parents and their pre-school aged children were observed interacting to see if there was a link between input from parents, and children's language development by child's sex.

9. Hart, S. A., Ganley, C. M., Purpura, D. J., (2016). Understanding the Home Math Environment and its Role in Predicting Parent Report of Children's Math Skills. *PLoS ONE*. 11(12), 1-30.

   This publication described a study investigating the home mathematics environment and the role it plays in children's math development. Researchers examined how the home environment affected both numeracy and spatial skills. Parents who did general math activities at home indicated having children with higher math skills, whereas parents who engaged in spatial activities indicated their children had lower math skills.

10. UNESCO, UNICEF, Brookings Institution and the World Bank, (2017). Measuring Early Learning Quality and Outcomes (MELQO).

    This is a report from a multi-country approach to improving early childhood education (4 - 6-year-olds) by reviewing existing tools to evaluate the quality of children's learning environments. Also, two modules were created on child development and early learning. The Measure of Development and Early Learning (MODEL), and the Measure of Early Learning Environments (MELE).

11. Jirout, J. J., Newcombe, N. S., (2015). Building blocks for developing spatial skills: evidence from a large, representative U.S. sample. *Psychological Science*. *26*(3), 302-310.

    This article described a study investigating spatial play at home utilizing a Home Environment Questionnaire. The survey asked parents of 4-7-year-old children to evaluate time devoted to spatial activities and compared these findings to children's spatial performance using the Wechsler Preschool and Primary Scale of Intelligence.

Item Development

Researchers culled all relevant items and categorized them into themes that emerged to begin designing questions to better understand more about children's home spatial environment. Themes included: manipulating or building things with two-dimensional or three-dimensional objects, use of spatial language, mathematics and numeracy, and awareness in space. We created an initial draft of the questionnaire with 31 questions. Researchers then determined that the survey was too long, and questions were either eliminated or combined to fit onto a double-sided 8.5" x 11" sheet of paper.

The final version was 17 questions in length. Table 1 describes the questionnaire items and their source reference. We decided to administer the survey via a paper form so that it could be distributed to students in their weekly "take home folder." We used Teleform® because of its ease of scoring, verification of accuracy of responses, and conversion of responses into an electronic database. The top of the questionnaire asked identifying questions of the student (first and last name), the teacher, and the school, as well as the student's gender, their grade level, and the survey responder's relationship to the student. The instructions stated: "Please complete this survey about the types of activities your child engages in at home. Select only one option for each question. Please promptly return to your child's teacher." The scale used for each response was based on the frequency with which parents observed their children or engaged with their children in a specific activity. Response options included: "Never", "About 1-2 times per month", "About 1-2 times per week", and "Almost daily". We also translated the survey into a Spanish version to allow for families whose first language was Spanish to respond. A copy of the final questionnaires can be found in Appendix A (English) and Appendix B (Spanish).

Table 1

Questionnaire items by source reference

Item Theme	Item Stem	Reference
Manipulating/building 2D or 3D objects	1. About how often does your child play with **puzzles**?	Zippert & Rittle-Johnson, 2018
Manipulating/building 2D or 3D objects	2. About how often does your child play with **blocks**?	Jirout & Newcombe, 2015
Manipulating/building 2D or 3D objects	3. About how often does your child play with **interlocking construction blocks** (i.e., free play with LEGO™ or DUPLO™ bricks)?	Jirout & Newcombe, 2015
Manipulating/building 2D or 3D objects	4. About how often do you *and* your child **build with construction toys** *together* (e.g., magnet sets, Lincoln logs)?	Zippert & Rittle-Johnson, 2018
Mathematics and numeracy	5. About how often does your child play with **board games that involve counting**, such as Chutes and Ladders?	Jirout & Newcombe, 2015
Awareness in space	6. About how often does your child solve or play with **connect the dot activities** (e.g., dot-to-dot puzzles)?	Zippert & Rittle-Johnson, 2018

Awareness in space	7. About how often does your child play with **mazes**?	Zippert & Rittle-Johnson, 2018
Mathematics and numeracy	8. About how often does your child use a computer, app, or interactive website to do **addition, subtraction, or other counting activities**?	Hart, Ganley, & Purpura, 2016
Manipulating/building 2D or 3D objects	9. About how often does your child use a computer, app, or interactive website to do **spatial tasks** (such as Tangrams or Tetris)?	Hart, Ganley, & Purpura, 2016
Manipulating/building 2D or 3D objects	10. About how often does your child use a computer, app, or interactive website to do activities involving **building things**?	Zippert & Rittle-Johnson, 2018
Mathematics and numeracy	11. About how often do you talk about **number skills** (i.e., counting, adding) with your child?	Jirout & Newcombe, 2015
Spatial language use	12. About how often do you talk about **shapes** (i.e., name the shape of an object) with your child?	MELQO MODEL, page 61
Awareness in space	13. About how often does your child **use a map** to find a location?	Created from discussions with research team
Manipulating/building 2D or 3D objects	14. About how often does your child **fold or cut paper to make 3D objects** (such as origami, paper airplanes)?	Hart, Ganley, & Purpura, 2016
Spatial language use	15. About how often do you assist or guide your child in **creating objects using step-by-step instructions** (e.g., LEGO™ model set)?	Ferrara, et al., 2011
Awareness in space	16. About how often does your child **draw maps** (such as treasure hunt maps)?	Hart, Ganley, & Purpura, 2016
Awareness in space	17. About how often does your child **draw plans for buildings** or spaces (e.g., houses, forts, castles, or other layouts)?	Hart, Ganley, & Purpura, 2016

Data Collection

We distributed the spatial reasoning home environment survey to students in grades K through two in participating schools. We asked teachers to distribute the survey via students' "take home" folder to maximize completion rates. In addition, we targeted students who were also included in the cognitive interviews (see Tech. Rep. No. 20-23) in order to draw connections between the cognitive interviews and the spatial activities that students engage in at home. The project specialist would periodically check with teachers at the two schools to ensure the return of the survey from parents.

Table 2 describes the sample of the students whose parents completed the home environment questionnaire. A majority of the students were from grade one, mostly female, and were from school A. School A is private catholic school in a large urban city in the south, and school B is a charter school in the same city.

Table 2

Student characteristics of parents surveyed

Characteristic		Count (%)
Grade		
	K	14 (26%)
	1	21 (38%)
	2	20 (36%)
Gender		
	Male	27 (49%)
	Female	28 (51%)
School		
	School A	38 (69%)
	School B	17 (31%)

Data Processing

The project specialist retrieved surveys from the school and began data processing upon arrival to the RME office. This included updating tracking spreadsheets, scanning of the Teleforms®, and deidentification of the surveys. We scanned the Teleforms® through the Teleform® reader located in the Center of Research and Evaluation (CORE) located at SMU. Once we scanned all data, we verified the data scanned, and CORE exported the data electronically via BOX.

Analysis

A researcher with the project conducted the analyses of the home environment questionnaire. After cleaning the data to remove fields specific to Teleform™ processing, the researcher described the sample of students by school, gender, and grade. Next, the researcher described the responses patterns with frequencies for each item. To understand the different constructs the survey might be measuring, the researcher conducted exploratory factor analyses. Exploratory factor analyses investigate the correlations between items to determine if clusters of items are measuring certain constructs (e.g., spatial reasoning). Lastly, the researcher conducted item-level correlations to describe the relations between each item. These results are described in the next section.

Results

Table 3 describes the response frequencies by survey item. We received 55 surveys, but in some instances, parents did not complete the back side of the survey, which provided smaller frequencies for some items.

Table 3

Item frequencies

	n	Never	Almost 1-2 times per **month**	Almost 1-2 times per **week**	Almost **daily**
About how often does your child play with **puzzles**?	55	8 (15%)	25 (45%)	17 (31%)	5 (9%)
About how often does your child play with **blocks**?	55	13 (24%)	15 (27%)	17 (31%)	10 (18%)
About how often does your child play with **interlocking construction blocks**?	55	8 (15%)	15 (27%)	16 (29%)	16 (29%)
*About how often do you and your child **build with construction toys** together?*	55	12 (22%)	24 (44%)	10 (18%)	9 (16%)
About how often does your child play with **board games that involve counting**?	55	11 (20%)	20 (36%)	22 (40%)	2 (4%)
About how often does your child solve or play with **connect the dot activities**?	55	8 (15%)	21 (38%)	22 (40%)	4 (7%)
About how often does your child play with **mazes**?	55	18 (33%)	19 (34%)	16 (29%)	2 (4%)
About how often does your child use a computer, app, or interactive website to do **addition, subtraction, or other counting activities**?	55	3 (6%)	10 (18%)	16 (29%)	26 (47%)
About how often does your child use a computer, app, or interactive website to do **spatial tasks**?	53	19 (36%)	8 (15%)	18 (34%)	8 (15%)
About how often does your child use a computer, app, or interactive website to do activities involving **building things**?	54	12 (22%)	12 (22%)	17 (32%)	13 (24%)
*About how often do you talk about **number skills** with your child?*	54	0 (0%)	3 (6%)	10 (19%)	41 (75%)

*About how often do you talk about **shapes** with your child?*	52	5 (10%)	9 (17%)	17 (33%)	21 (40%)
About how often does your child **use a map** to find a location?	54	20 (37%)	16 (30%)	12 (22%)	6 (11%)
About how often does your child **fold or cut paper to make 3D objects**?	54	12 (22%)	25 (46%)	12 (22%)	5 (10%)
*About how often do you assist or guide your child in **creating objects using step-by-step instructions**?*	54	28 (52%)	19 (35%)	3 (6%)	4 (7%)
About how often does your child **draw maps**?	54	20 (37%)	14 (26%)	11 (20%)	9 (17%)
About how often does your child **draw plans for buildings or spaces**?	53	21 (39%)	12 (23%)	11 (21%)	9 (17%)

Note: Italicized items represent activities in which parents engage with their child.

To understand the internal structure of the questionnaire, we conducted a series of exploratory factor analyses. We first constructed a scree plot, which provides a visual of the number of factors against the eigen values of principal factors (Figure 1). The scree plot indicated a three-factor model was appropriate for the data. Next, we conducted exploratory factor analyses without accounting for the clustering of students within school, and then accounting for the clustering. Accounting for the clustering provides better estimates for the standard errors because we expect responses to be correlated at the school level. In addition, we utilized a weighted least square estimator as the estimation technique to account for the categorical nature of the data. Table 4 describes the model fit indices with and without clustering.

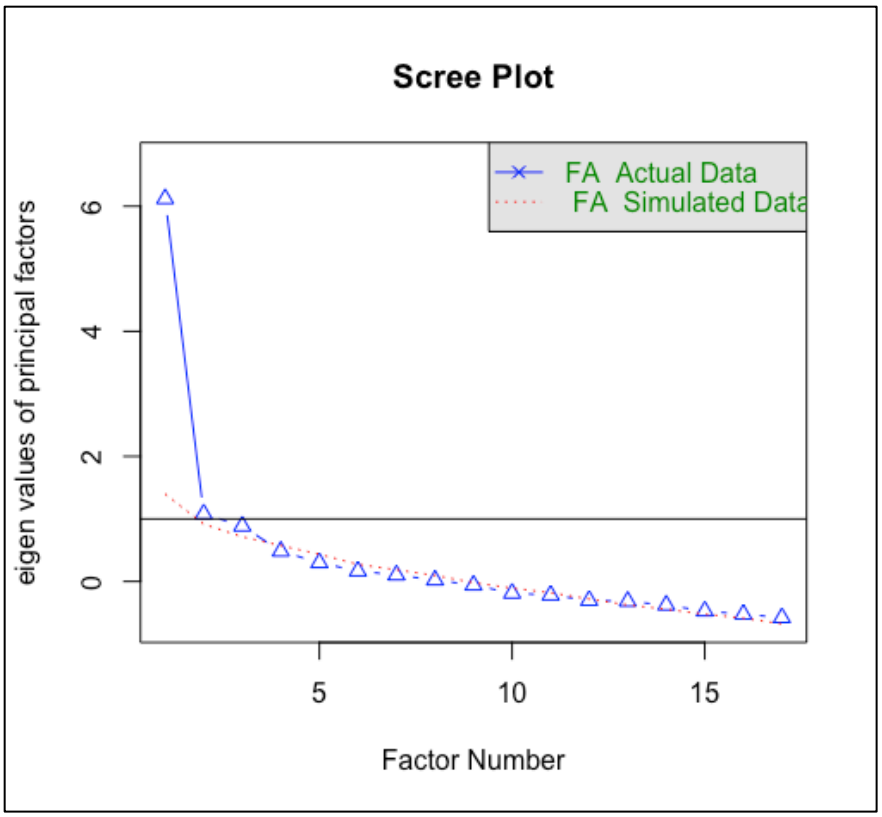

Figure 1. Scree plot for home use survey data

Table 4

Results from exploratory factor analyses

Model	CFI	TLI	RMSEA	90% CI	SRMR
No Clustering					
One Factor	.918	.906	.129	(.083,.169)	.163
Two Factors	.969	.958	.085	(.000,.137)	.114
Three Factors	.985	.977	.064	(.000,.126)	.085
Clustering					
One Factor	.989	.987	.176	(.153,.199)	.178
Two Factors	.996	.995	.111	(.081,.139)	.135
Three Factors	.997	.996	.104	(.071,.136)	.115

We assessed multiple indices for model fit. The root mean squared error of approximation (RMSEA) indicates a good fitting model when the value is less than .06 (Hu & Bentler, 1999). The comparative fit index (CFI) and the Tucker Lewis index (TLI) indicate a good model fit for values greater than or equal to .95 (Hu & Bentler, 1999). Lastly, the standardized root mean squared residual (SRMR) indicates a good model fit for values less than or equal to .08. Without accounting for clustering of students within schools, the CFI and TLI indices were worse than when accounting for clustering. Conversely, the RMSEA and SRMR are worse when accounting

for clustering. Whether accounting for clustering or not, the three-factor model provided the best fit. The factor loadings for the three-factor model are provided in Appendix C.

Lastly, we report the item-level correlations to better understand the relation between the items on the questionnaire. Table 5 provides the item correlations. Item correlations range between .04 to .71, which provide evidence of low to strong item-level correlations.

Next Steps

After careful evaluation of the results from the factor analysis, the team decided to redevelop the home use questionnaire to focus explicitly on spatial reasoning. In particular, we decided that the questionnaire should be more representative of the subcomponents listed within the spatial reasoning learning progression (Tech. Rep. No. 20-06). Furthermore, we redistributed the survey to include more parents. For details on the redevelopment of the survey, see the Spatial Reasoning Home Environment Questionnaire Phase 2 Development technical report (Tech. Rep. No. 20-30).

Table 5

Item correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1.0	.56***	.38**	.50***	.39**	.46***	.31**	.11	.14	.10	.26	.30*	.32*	.34*	.35**	.04	.46***
2		1.0	.55***	.71***	.37**	.43***	.38**	.36**	.30*	.35*	.28*	.59***	.35**	.37**	.53***	.26	.53***
3			1.0	.61***	.21	.28*	.45***	.19	.05	.23	.25	.33*	.21	.29*	.46***	.15	.37**
4				1.0	.49***	.53***	.33*	.57***	.38**	.28*	.38**	.44**	.27*	.51***	.53***	.25	.45***
5					1.0	.62***	.49***	.44***	.42**	.19	.41**	.39**	.15	.37**	.34*	.32*	.39**
6						1.0	.64***	.36**	.34*	.29*	.37**	.41**	.21	.51***	.45***	.44***	.43**
7							1.0	.26	.30*	.33*	.36**	.45***	.29*	.40**	.37**	.55***	.39**
8								1.0	.42**	.37**	.45***	.25	.13	.33*	.34*	.39**	.12
9									1.0	.51***	.11	.17	.17	.20	.34*	.64***	.40**
10										1.0	.04	.19	.28*	.30*	.42**	.63***	.38**
11											1.0	.43**	.04	.44***	.22	.17	.31*
12												1.0	.29*	.32*	.21	.31*	.31*
13													1.0	.38	.57***	.24	.39**
14														1.0	.48***	.27*	.44***
15															1.0	.40**	.69***
16																1.0	.37**
17																	1.0

Note: *< .05, **< .01, ***<.001

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Appendix A – English Version of Questionnaire

Spatial Relations Home Environment Questionnaire

Important: Please fill out this form using a blue or black pen only.

Student's First Name: ϒϒϒϒϒϒϒϒϒϒ Student's Last: ϒϒϒϒϒϒϒϒϒϒ

Student's gender: O Male O Female Teacher Name: ϒϒϒϒϒϒϒϒϒϒ

Student's Grade (K, 1, 2, 3): ϒ School Name: ϒϒϒϒϒϒϒϒϒϒ

Instructions: Please complete this survey about the types of activities your child engages in at home. Select only **one** option for each question. Please promptly return to your child's teacher.

What is your relationship to this student?

O Parent O Grandparent O Guardian O Other: ϒϒϒϒϒϒϒϒϒϒϒϒϒϒϒϒ

1. About how often does your child play with **puzzles**?

   O Never O About 1-2 times per **month** O About 1-2 times per **week** O Almost **daily**

2. About how often does your child play with **blocks**?

   O Never O About 1-2 times per **month** O About 1-2 times per **week** O Almost **daily**

3. About how often does your child play with **interlocking construction blocks** (i.e., free play with LEGO™ or DUPLO™ bricks)?

   O Never O About 1-2 times per **month** O About 1-2 times per **week** O Almost **daily**

4. About how often do you *and* your child **build with construction toys** *together* (e.g., magnet sets, Lincoln logs)?

   O Never O About 1-2 times per **month** O About 1-2 times per **week** O Almost **daily**

5. About how often does your child play with **board games that involve counting**, such as Chutes and Ladders?

   O Never O About 1-2 times per **month** O About 1-2 times per **week** O Almost **daily**

6. About how often does your child solve or play with **connect the dot activities** (e.g., dot-to-dot puzzles)?

   ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

7. About how often does your child play with **mazes**?

   ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

8. About how often does your child use a computer, app, or interactive website to do **addition, subtraction, or other counting activities**?

   ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

9. About how often does your child use a computer, app, or interactive website to do **spatial tasks** (such as Tangrams or Tetris)?

   ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

10. About how often does your child use a computer, app, or interactive website to do activities involving **building things**?

    ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

11. About how often do you talk about **number skills** (i.e., counting, adding) with your child?

    ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

12. About how often do you talk about **shapes** (i.e., name the shape of an object) with your child?

    ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

13. About how often does your child **use a map** to find a location?

    ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

14. About how often does your child **fold or cut paper to make 3D objects** (such as origami, paper airplanes)?

    ○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

15. About how often do you assist or guide your child in **creating objects using step-by-step instructions** (e.g., LEGO™ model set)?

○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

16. About how often does your child **draw maps** (such as treasure hunt maps)?

○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

17. About how often does your child **draw plans for buildings** or spaces (e.g., houses, forts, castles, or other layouts)?

○ Never ○ About 1-2 times per **month** ○ About 1-2 times per **week** ○ Almost **daily**

Appendix B – Spanish Version of Questionnaire

Cuestionario Sobre Relaciones Espaciales en el Ambiente Hogareño

Importante: Por favor, rellene este formulario solo con un bolígrafo azul o negro.

Nombre del estudiante: ϒϒϒϒϒϒϒϒϒϒ Apellido: ϒϒϒϒϒϒϒϒϒϒ

Género del estudiante: O Hombre O Mujer Nombre del maestro: ϒϒϒϒϒϒϒϒϒϒ

Año escolar del estudiante (K, 1, 2, 3): ϒ Nombre de la escuela: ϒϒϒϒϒϒϒϒϒϒϒ

Instrucciones: Por favor, complete esta encuesta sobre los tipos de actividades en las que su hijo participa en casa. Seleccione solo **una** opción para cada pregunta. Por favor, vuelva a ver al maestro de su hijo con prontitud.

¿Cuál es su relación con este estudiante?

O Padre O Abuelo O Tutor O Otro: ϒϒϒϒϒϒϒϒϒϒϒϒϒϒϒϒϒϒ

17. ¿Con qué frecuencia juega su hijo con **rompecabezas**?

    ONunca O1-2 veces al **mes** O1-2 veces a la **semana** O Prácticamente **a diario**

18. ¿Con qué frecuencia juega su hijo con **bloques**?

    ONunca O1-2 veces al **mes** O1-2 veces a la **semana** O Prácticamente **a diario**

19. ¿Con qué frecuencia juega su hijo con **bloques de construcción entrelazados** (por ejemplo, juego libre con LEGO™ o DUPLO™ bricks)?

    ONunca O1-2 veces al **mes** O1-2 veces a la **semana** O Prácticamente **a diario**

20. ¿Aproximadamente con qué frecuencia usted *y* su hijo construyen con **juguetes de construcción** *juntos* (por ejemplo, juegos de imanes, troncos de Lincoln)?

    ONunca O1-2 veces al **mes** O1-2 veces a la **semana** O Prácticamente **a diario**

21. ¿Con qué frecuencia juega su hijo **con juegos de mesa que involucran contar**, tales como Chutes y Ladders (Paracaídas y escaleras)?

    ONunca O1-2 veces al **mes** O1-2 veces a la **semana** O Prácticamente **a diario**

22. ¿Con qué frecuencia su hijo resuelve o juega a las **actividades de conectar los puntos** (por ejemplo, puzles punto a punto)?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

23. ¿Con qué frecuencia juega su hijo con **laberintos**?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

24. ¿Con qué frecuencia su hijo usa la computadora, una aplicación o un sitio web interactivo para hacer **sumas, restas u otras actividades de conteo**?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

25. ¿Con qué frecuencia utiliza su hijo una computadora, una aplicación o un sitio web interactivo para realizar **tareas especiales** (como Tengrams o Tetris)?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

26. ¿Con qué frecuencia utiliza su hijo una computadora, un aplicación o un sitio web interactivo para realizar actividades **relacionadas con la construcción**?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

27. ¿Con qué frecuencia usted habla acerca de **las habilidades numéricas** (por ejemplo, contar, sumar) de su hijo?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

28. ¿Con qué frecuencia usted habla de **las formas** (por ejemplo, nombre de la forma de un objeto) con su hijo?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

29. ¿Con qué frecuencia utiliza su hijo **un mapa** para encontrar un lugar?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

30. ¿Con qué frecuencia **dobla o corta papel para hacer objetos en 3D** (como origami, aviones de papel)?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

31. ¿Con qué frecuencia asiste o guía a su hijo en **la creación de objetos utilizando instrucciones paso a paso** (por ejemplo, juego de modelos LEGO™)?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

32. ¿Con qué frecuencia su hijo **dibuja mapas** (como los mapas de la caza del tesoro)?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

17. ¿Con qué frecuencia su **hijo dibuja planos de edificios** o espacios (por ejemplo, casas, fuertes, castillos u otros diseños)?

○Nunca ○1-2 veces al **mes** ○1-2 veces a la **semana** ○ Prácticamente **a diario**

Appendix C – Results of Complex Exploratory Factor Analysis

Factor loadings by item

	F1	F2	F3
About how often does your child play with **puzzles**?	.644*	-.006	.284*
About how often does your child play with **blocks**?	.602*	.108*	.327*
About how often does your child play with **interlocking construction blocks**?	.628*	-.013	.125*
*About how often do you and your child **build with construction toys** together?*	1.00*	.165*	.013*
About how often does your child play with **board games that involve counting**?	.251*	.644*	.032*
About how often does your child solve or play with **connect the dot activities**?	.290*	.489*	.249*
About how often does your child play with **mazes**?	.005	.714*	.230
About how often does your child use a computer, app, or interactive website to do **addition, subtraction, or other counting activities**?	-.057	.766*	-.007
About how often does your child use a computer, app, or interactive website to do **spatial tasks**?	.073*	.546*	.065
About how often does your child use a computer, app, or interactive website to do activities involving **building things**?	-.153*	.220*	.578*
*About how often do you talk about **number skills** with your child?*	.333*	.628*	-.123*
*About how often do you talk about **shapes** with your child?*	.497*	.525*	-.025*
About how often does your child **use a map** to find a location?	.092	-.067	.593*
About how often does your child **fold or cut paper to make 3D objects**?	.357*	-.010	.504*

*About how often do you assist or guide your child in **creating objects using step-by-step instructions**?*	.011	.271*	.738*
About how often does your child **draw maps**?	-.322*	.603*	.458*
About how often does your child **draw plans for buildings or spaces**?	.134	.002	.901*