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Effect of Socioeconomic Environment on Understanding and Producing Mathematical Vocabulary in Preschool Children

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Supplementary Materials: Data, Materials [see Index of Supplementary Materials]

Abstract

We investigated the development of mathematical vocabulary understanding in young French children aged 3 to 6 years old as a function of the socioeconomic environment. A total of 306 French children were administered two tasks, respectively assessing their understanding and production of French mathematical vocabulary. The results showed differences in understanding and production of mathematical vocabulary between children in preschool/kindergarten Grade Levels 1 (3-4 yo), 2 (4-5 yo), and 3 (5-6 yo). Children from REP+ ("Réseau d'Education Prioritaire") schools (that concerned neighborhoods or isolated sectors with the greatest concentrations of social difficulties) understood and produced less numerous mathematical terms than those from regular schools, whatever the grade level. Theoretical and practical contributions for teaching are discussed. Despite the measures as a priority education policy organized by the government in REP+ schools, the school fails to reduce the impact of social inequalities on mathematical vocabulary. Efficient intervention is therefore needed.

Keywords

mathematical vocabulary, children, preschool, socioeconomic environment

Mathematical vocabulary is essential for developing mathematical competencies, such as calculation and word-problem solving (e.g., Vanluydt et al., 2021). It has been shown that there was a strong link between the socioeconomic environment and the math talk used at home by parents on the one hand (Dearing et al., 2022) and between the math talk used at home by parents and the math talk used by their children on the other hand (Masek et al., 2024). There was, therefore, reason to believe that the socioeconomic environment may influence children's mathematical vocabulary knowledge. Our study aimed to understand how mathematical vocabulary develops in the early ages and to assess whether the school environment (a measure of the socioeconomic level) would have an impact on preschool children's quantitative and spatial mathematical vocabulary understanding and production knowledge. This impact was considered from the beginning (3-4 years old, Grade Level 1) to the end (5-6 years old, Grade Level 3) of the preschool curriculum. Answering these questions was thus essential to enable every child to think, understand, and produce mathematical ideas precisely.

Definition of Mathematical Vocabulary

In scientific literature, the notion of mathematical vocabulary does not have a strictly consensual definition. Some authors consider mathematical vocabulary to include terms with a so-called spatial component (e.g., behind, next to, between; Ramani et al., 2014) and a quantitative dimension (e.g., some, more, less; Barner et al., 2009). They also include number words in mathematical vocabulary. This is notably the case with Powell, who conceives mathematical vocabulary as the set of terms used to define concepts and procedures specific to mathematics (Powell & Nelson, 2017). On the contrary, other authors, such as Purpura, explain the concept of mathematical vocabulary by including only spatial and quantitative terms and excluding number words (Purpura & Logan, 2015). Furthermore, both "mathematical vocabulary" (Powell & Driver, 2015) and "mathematical language" (Purpura & Reid, 2016; Turan & De Smedt, 2023) terms have been used to define mathematics-specific content terms and concepts. In the current paper, we will use the "mathematical vocabulary" terminology to designate spatial and quantitative terms, excluding number words (that have a specific number meaning and are directly used in number activities such as calculation). We used this terminology and this definition in the present study.

Different categories of mathematical vocabulary have been described. The quantitative mathematical vocabulary refers to the manipulation or comparison of object or number sets (Purpura & Reid, 2016). It contains terms describing quantities (e.g., several, many, a few), describing actions that can be performed on quantities (e.g., add, subtract), or terms used to compare quantities (e.g., equal, less than). Spatial mathematical terms (e.g., before, after, between) describe relations between physical objects or numbers (Purpura & Reid, 2016).

Importance of Mathematical Vocabulary

Mathematical vocabulary has an important role in children's development. In 3- and 4-year-old children, mathematical vocabulary knowledge correlates with the general performance in mathematics, assessed at the same age and later (verbal rote counting, counting, number identification, word-problem solving, and geometry; Hornburg et al., 2018, 2024; Lin et al., 2021; Turan & De Smedt, 2023). In typically-developing children (see Lafay et al., 2023 for a review), mathematical vocabulary knowledge is a strong predictor of mathematical skills (e.g., comparing sets and Arabic numbers; Hornburg et al., 2024; Purpura & Logan, 2015; Purpura & Reid, 2016; word-problem solving; Vanluydt et al., 2021; Xu et al., 2022), and even literacy (e.g., letter recognition, phonological awareness; Purpura et al., 2017) or executive functions (Schmitt et al., 2019).

In the current study, we used the *developmental function hypothesis of language for mathematics* (Peng et al., 2020) as a theoretical framework. According to this hypothesis, language first has a role in thinking: Understanding mathematical vocabulary allows children to think about mathematical ideas. Second, language has a role as a medium in allowing ideas to be expressed: Producing mathematical vocabulary makes children able to communicate, represent, and retrieve mathematical ideas. Aligned with this hypothesis, mathematical vocabulary facilitates the learning of mathematical reasoning (Ho et al., 2025; Lin et al., 2021; Peng et al., 2020).

On the one hand, understanding how mathematical vocabulary develops is essential to enable every child to think and understand mathematical ideas precisely. Studies that have been presented above focused on mathematical vocabulary understanding, most of them in English, and highlighted the importance of mathematical vocabulary understanding in mathematical development in children schooled in kindergarten and primary. There is, however, very limited empirical information on French preschool children's understanding of mathematical vocabulary (Lafay & Helloin, 2025). This later study presented some limitations that we try to address here. It first targeted children from 4 years old, while the current study is interested in younger children from 3 years old, and this allowed us to evaluate young children in the very early schooling when the formal instruction has not started yet. Second, it used tasks of mathematical vocabulary knowledge containing a restricted number of quantitative terms only, whereas our study assessed both quantitative and spatial mathematical vocabulary with a task containing a larger number of terms to provide a broader observation, offering a broader view of children's knowledge. Furthermore, we proposed an evaluation of both quantitative and spatial terms, because it is included in the mathematical vocabulary definition (Powell & Nelson, 2017; Purpura & Logan, 2015) and because quantitative and spatial mathematical vocabulary relates to facets of numeracy in different ways (Chan et al., 2025): For example, spatial vocabulary has been identified as a determinant of spatial mathematical abilities (Balcomb et al., 2011; Newcombe & Frick, 2010), as well as of general mathematical performance that does not necessarily involve spatial aspects

(Bower et al., 2020). Moreover, quantitative vocabulary has been causally linked more specifically to performance in calculation or numeracy (King & Purpura, 2021; Purpura et al., 2019).

On the other hand, producing accurate mathematical terms is essential to communicating, representing, and retrieving mathematical ideas. To date, most previous studies have not investigated mathematical vocabulary production, that is the expression of mathematical terms. Bryant et al. (2024) measured the spontaneous production of quantitative and spatial terms while watching 24 preschoolers (from 3 ½ years old to 5 ½ years old) engage in block-building play and observing how they used mathematical language. They showed that 3-6-year-old children spontaneously used a higher raw frequency of spatial mathematical language terms compared to quantitative mathematical language terms during block play sessions. However, this study examined only vocabulary spontaneously generated by children, not the use of controlled and specific terms. Furthermore, Bryant et al. (2024)'s study analyzed the mathematical terms that 3-6-year-old children produced, but proposed an analysis of the spontaneous production and did not analyze the developmental aspects of the production. At different ages, children may be able to produce mathematical terms without spontaneously producing them. The current study thus addressed these limitations: We analyzed the development of mathematical vocabulary understanding and production in children aged from 3 to 6 years old with a task considering two types of terms: spatial and quantitative terms.

Link Between the Socioeconomic Environment and Mathematical Vocabulary

First, a strong link between socioeconomic environment and general vocabulary has been shown in early childhood. Children from disadvantaged backgrounds have less elaborate linguistic skills (Qi et al., 2006). Indeed, the vocabulary size of children from disadvantaged environments was lower than that of their peers from more advantaged backgrounds (Hoff, 2003; Pan et al., 2005). An explanation may lie in a less enriched linguistic environment—both in terms of the quantity and quality of input—combined with less frequent verbal interactions between children and adults, even when provided by parents from more advantaged backgrounds (Levickis et al., 2020).

Second, numerous studies have shown a strong link between socioeconomic environment and mathematics performance, and that the home numeracy environment causally influenced children's numerical development (Girard et al., 2025). Socioeconomic environment, attitudes and beliefs towards mathematics, and engagement in activities with mathematical content are thus factors that influence learning in mathematics (Silver & Libertus, 2022). Children from disadvantaged backgrounds (low socioeconomic environment) are more likely to encounter academic difficulty than their peers (Liu et al., 2022). They are more likely to start school with lower mathematical scores (Duncan & Magnuson, 2011; Gjicali et al., 2019; Johnson et al., 2022; Jordan et al., 1994). For example, Berger et al. (2025) showed, in a sample of 571 3-6-year-old French children, a significant relation between the socioeconomic environment and numeracy skills (such as counting, subitizing, and small calculation).

In the same way, Jordan et al. (1992, 1994) showed that preschoolers and kindergartners from low socioeconomic environments had similar performance than those from moderate-to-high socioeconomic environments in solving non-verbal arithmetic problems, but they were less successful in solving symbolic problems and word problems. This disadvantage for symbolic and word problems may stem from the fact that the socioeconomic environment predicts language level (Merz et al., 2019): Children from disadvantaged low socio-economic backgrounds often have a less elaborate language level, particularly in terms of general vocabulary (Meir & Armon-Lotem, 2017).

Indeed, Masek et al. (2024) measured the mathematical vocabulary spontaneously produced by very young children (2-3 years old) during interactions with their parents when they were playing different games (picture book, grocery shopping, shape sorter, or magnet board). In this study, children produced math talk (either quantitative or spatial) that depended on the play type and parents' math talk. Indeed, a strong link between the socioeconomic environment and the math talk used at home by parents has been shown (Dearing et al., 2022; Lu et al., 2025). There is therefore reason to believe that the socioeconomic environment may influence children's mathematical vocabulary knowledge: If the socioeconomic environment is linked to mathematical performance via linguistic abilities, we would expect an effect of the socioeconomic environment to be even more true when considering mathematical language. With regression analysis, Purpura and Reid (2016) demonstrated that variance accounted for mathematical vocabulary in American 3-5-year-old preschool children in middle- to high socioeconomic environment families: At this age, children have already acquired fundamental mathematical vocabulary understanding, but those whose parents have a moderate level of education often have less developed mathematical vocabulary understanding than those from high socioeconomic environment families. According to Bleses et al. (2023), the mathematical vocabulary understanding of 3-5-year-old Danish children was related to their family socioeconomic environment: The mathematical vocabulary of children having mothers with only a primary education was overall lower than that of children having mothers with a postgraduate degree.

There is, however, no data on French children's mathematical vocabulary knowledge according to their socioeconomic environment. Studying French children's mathematical vocabulary is fundamental since the French language structure is sometimes very different from the English language structure. For example, while English speakers say, "He is bigger than you" (using the -er comparative structure), French speakers say, "Il est plus gros que toi" (literally meaning "He is more big than you"). Likewise, while English speakers say, "He has more cherries than you," French speakers say "Il a plus **de** cerises que toi" (literally meaning "He has more **of** cherries than you"). Because there are few regularities and more variations in the lexical forms in the French language, this difference in the language structure may impact the acquired knowledge at different ages. Moreover, studying the impact of the socioeconomic environment in France was interesting because of the particular organization of the school system. First, French children start to go to school at 3 years old (Grade Level 1), so that situation creates an opportunity to study the impact of the socioeconomic environment in very young children before formal schooling (in the very early schooling when the formal instruction has not started yet). Second, public schools in France are categorized as "regular," "Priority Education Area" (Réseau d'Education Prioritaire," REP), or "Priority Education Area +" (Réseau d'Education Prioritaire +," REP+) (Ministère de l'Education Nationale, 2014). REP+ concerns neighborhoods or isolated sectors with the greatest concentrations of social difficulties that have a strong impact on academic success. Compared to regular schools and schools outside the priority education zone, REP faces more substantial social challenges despite having a more diverse student body. A priority education strategy has been developed by the French government to reduce the effect of social inequality on academic performance. For example, schools in underprivileged communities receive more funding. Additional consultation and training sessions for teachers, who are urged to implement educational initiatives that are likely to lessen disparities among students, are another way by which the priority education policy is accomplished (Ministère de l'Education Nationale, 2014). Furthermore, there are fewer students in classrooms, allowing a better individualization of teaching. That situation represents an opportunity to explore the effect of schooling and its interaction with the socioeconomic environment effect. In this French context, we deliberately chose to investigate the effect of the socioeconomic environment in studying the effect of the school environment, because most children in REP+ come from very disadvantaged socioeconomic environments and because we aimed to disentangle whether the school can reduce children's difficulties when entering in school.

The general objective was to investigate the development of mathematical vocabulary understanding and production in young French children aged from 3 to 6 years old. More particularly, the current study aimed to assess whether children at the end of preschool (5-6 years old, Grade Level 3) would have a better understanding and production of quantitative and spatial mathematical vocabulary than those at the middle of preschool (4-5 years old, Grade Level 2) who would be better than those at the beginning of preschool (3-4 years old, Grade Level 1), and if these differences would be different according to the school environment (related to the socioeconomic environment). We chose to investigate both quantitative and spatial mathematical vocabulary (Purpura & Reid, 2016) and both understanding and production (Peng et al., 2020) for an overall picture.

Current Study

Our study aimed to assess whether the school environment would have an impact on the beginning (3-4 years old, Grade Level 1) to the end (5-6 years old, Grade Level 3) of preschool children's quantitative and spatial mathematical vocabulary understanding and production knowledge and acquisition. In France, public schools are classified (Ministère de l'Education Nationale, 2014) as "regular" schools, as "Priority Education Area" schools ("Réseau d'Education Prioritaire," REP), or as "Priority Education Area +" schools ("Réseau d'Education Prioritaire +," REP+). REP+ concerns neighborhoods or isolated sectors with the greatest concentrations of social difficulties that have a strong impact on academic success. REP is more socially mixed but encounters more significant social difficulties than those of middle schools and schools outside the priority education zone. The REP+ schools were ranked as such because they showed a poor IPS ("Indice de Position sociale", Rocher, 2023), an index calculated by the Directorate of Evaluation, Prospective, and Performance of the French Ministry of National Education and Youth. This index was related to the socioeconomic and cultural conditions of children's families attending an educational establishment and was derived from the professions and social categories of the parents (Rocher, 2016). The following three research questions guided the study:

1. Did children show difference in their understanding and production of quantitative and spatial mathematical vocabulary in the same way from the beginning (3-4 years old, Grade Level 1) to the end (5-6 years old, Grade Level 3) of preschool? We assumed that children schooled in Grade Level 1[1] would be lower than children schooled in Grade Level 2, who would be lower than children schooled in Grade Level 3 (Hypothesis 1). Since 2-3-year-old children's understanding and production were related to math talk of their parents on the one hand, and since parents spontaneously produced more spatial than quantitative terms on the other hand (Masek et al., 2024), we expected that children would understand and produce fewer quantitative than spatial terms when starting school. However, because of schooling with a curriculum focused on number skills (Ministère de l'Education Nationale, 2024), we expected that children would show better quantitative terms understanding and production with age.
2. Did children's understanding and production of mathematical vocabulary depend on the school environment? Because the socioeconomic environment has an impact on general mathematical abilities (Jordan et al., 1994; also Berger et al., 2025, with

1) The current study took place in France where children start to go to school at 3 years old: In preschool, children are schooled at 3-4 years old in "Petite Section de Maternelle" (Grade Level 1), at 4-5 years old in "Moyenne Section de Maternelle" (Grade Level 2), and at 5-6 years old in "Grande Section de Maternelle" (Grade Level 3). In the whole article, we refer to schooling in preschool to describe the three levels of preschool.

French children) and on language acquisition (Meir & Armon-Lotem, 2017; also Berger et al., 2025, with French children), we, therefore, assumed that children from REP+ (lowest socioeconomic environment) would be lower than children from regular schools (moderate-to-high socioeconomic environment) (Hypothesis 2).

3. Did the school environment have a different impact on children's understanding and production of mathematical vocabulary as a function of the grade level? In France, there is a priority education policy aimed at reducing the impact of social inequalities on performance at school. Additional resources are allocated to schools in disadvantaged areas. The priority education policy is also achieved through additional consultation and training times for teachers, who are encouraged to adopt educational actions likely to reduce inequalities between children (Ministère de l'Education Nationale, 2014). If the school system succeeds in reducing inequalities, we, therefore, should observe a difference in understanding and production of mathematical vocabulary between children from REP+ and those from regular schools when children began school (3-4 years old, Grade Level 1), but the gap should be reduced when they finished preschool (5-6 years old, Grade Level 3) (Hypothesis 3).

Method

Participants

The Savoie school district direction (i.e., Direction des Services Départementaux de l'Éducation Nationale, DSDEN), attached to the Académie de Grenoble, supported the project and gave authorization to contact schools. The kindergarten pedagogical consultant who worked on the project presented it to the schools by email. The project was then presented to the teachers by email and during a meeting, and they could participate voluntarily. Once the teachers were willing to participate, a flyer and a letter of information were given to each student's parent. In total, 18 teachers voluntarily accepted to participate in the study, which represented a total of 347 children. Some parents did not consent to their child's participation; some children were absent on the day of the data collection; some children were not willing to participate (for example, sometimes, they were too shy and refused to talk, sometimes they did not want to miss a classroom activity) (11.8% in total).

In the final sample, 306 children aged from 3 to 6 years old participated as subjects. They were enrolled in preschool public schools in the first grade level curriculum (Grade Level 1: n = 85; aged of 3-4 years old), in the second grade level curriculum (Grade Level 2: n = 102; aged of 4-5 years old), and in the third grade level curriculum (Grade Level 3: n = 119; aged of 5-6 years old). Children were recruited in six schools in a very large area of the Savoie department (France, 73): Two schools were classified as a “Priority Education Area +” school (“Réseau d’Education Prioritaire +,” REP+; n = 119), whereas four schools were classified as “regular” school (n = 185). Therefore, we constituted two groups of children: a group of children schooled in regular schools (n = 187; Grade Level 1: n = 56; Grade Level 2: n = 58; and Grade Level 3: n = 73) and a group of children schooled in REP+ schools (n = 119; Grade Level 1: n = 29; Grade Level 2: n = 44; and Grade Level 3: n = 46).

General Procedure

The project was approved by the Human Research Ethics Committee of the Université Savoie Mont Blanc (certificate number 2023-30-LEXIM). Children were individually met by a researcher (authors) or a master's student supervised by the authors. The meeting took place in a calm room in the children’s school, lasted between 15 and 25 minutes, and was conducted between February and May 2024. The experimenters started with a task assessing the production of mathematical terms and then a task assessing the understanding of mathematical terms.

Measures

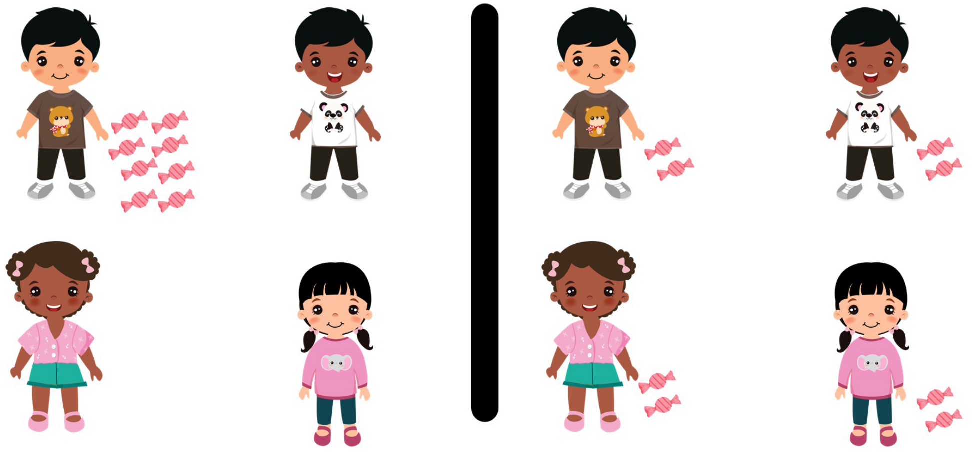
Understanding of Mathematical Vocabulary Task

A measure of the understanding of French mathematical vocabulary was constructed for the current study. In the *C-MathéMOTiques* task (C for “comprehension” in French), children were presented with one example and 47 items: 28 quantitative terms (e.g., *more … than*, each; see Figure 1) and 19 spatial terms (e.g., *below*, *between*; see Figure 2). For each item, children were shown an image containing two images separated by a black line. They were told a short sentence containing a mathematical term, and they were asked to point out the correct image. Each item was scored 1 point if the response was correct. The total quantitative understanding score was 28, while the total spatial understanding score was 19. It was transformed into a percentage of correct responses, namely the mathematical vocabulary understanding score.

The *C-MathéMOTiques* task has been developed following a validation procedure. First, the two researchers listed all the mathematical terms included in the assessment tasks described in the scientific publication (English or French; e.g., Purpura & Reid, 2016) and in some picture books focused on mathematical language (e.g., The Little Elephants' BIG Adventures). Second, they translated the English terms into French. Third, they identified all the mathematical terms used in the National Assessment administered during primary school first and second grades (6-8 years old). Fourth, five preschool teachers from the collaborative research (who also participated to the study since their students were tested) were asked to classify the terms in order of importance according to the grade level. Fifth, the 28 quantitative and 19 spatial terms were selected. The task had a strong internal consistency with a high Cronbach’s alpha (α = .877).

Figure 1

Example of a Quantitative Term Item for Both Understanding and Production Tasks



Note. For the understanding task, the targeted sentence was “Les bonbons sont **partagés**” meaning “The gummies are **shared**” and children may point out the right image. For the production task, the sentence was “Ici, les bonbons sont pour un seul enfant. Là, les bonbons sont ...” meaning “Here, the gummies are for one child only. Here, the gummies are...”; the waited response was “**partagés**” meaning “**shared**.”

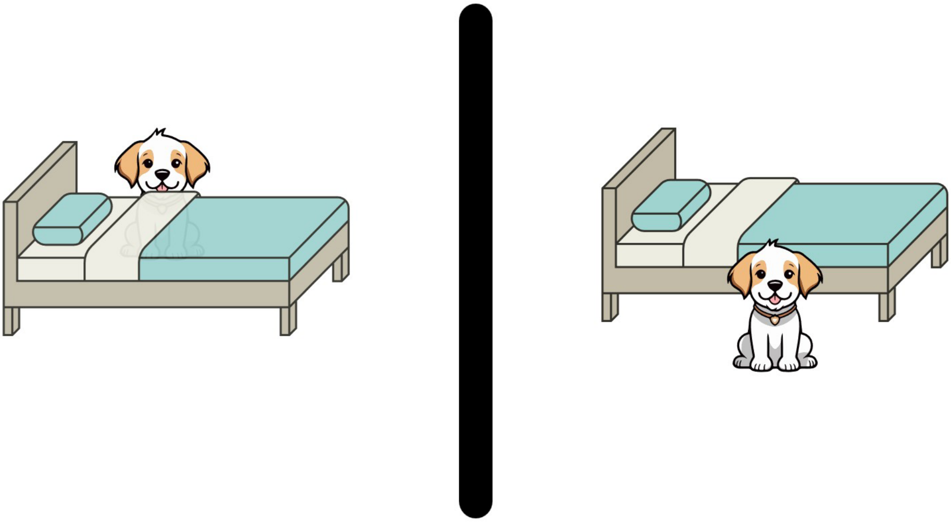
Production of Mathematical Vocabulary Task

A measure of the production of French mathematical vocabulary was constructed for the current study. The *P-MathéMOTiques* task has been developed following a validation procedure identical to that of the *C-MathéMOTiques* task. In the *P-MathéMOTiques* task, children were presented with one example and 47 items: 28 quantitative terms (e.g., *more ... than*, *each*; see Figure 1) and 19 spatial terms (e.g., *below*, *between*; see Figure 2). For each item, children were shown an image containing two images separated by a black line. They were told a short sentence containing a mathematical term when the experimenter was pointing the image to the left, and then, they were told the beginning of a sentence when the experimenter was pointing the image to the right; children were asked to complete the sentence.

Each item was coded as correct or incorrect. For example, the response "below the clouds," as opposed to "above the clouds" was coded as correct but the responses "under the clouds" and "beneath the clouds" were coded as incorrect. We also created a less severe production score (the concept score): We accepted as correct each word or term that was semantically equivalent. For example, the response "below the clouds," "under the clouds," and "beneath the clouds" as opposed to "above the clouds" was coded as correct.

Figure 2

Example of a Spatial Term Item for Both Understanding and Production Tasks



Note. For the understanding task, the targeted sentence was “Le chien est **derrière** le lit” meaning “The dog is **behind** the bed” and children may point out the left image. For the production task, the sentence was “Ici, le chien est derrière le lit. Là, le chien est …” meaning “Here, the dog is behind the bed. Here, the dog is …”; the waited response was “**devant (le lit)**” meaning “**in front of the bed**.”

The coding was performed by four independent raters. First, the master’s students entered the exact words said by the children. Then, two coders (MB and CR) categorized each response of the entire sample. Then, two researchers (AL and CB) coded 20% of the sample (60 participants). The percentage of agreement between the two pairs of coders was 92.1%, suggesting strong inter-rater reliability. Discrepancies were discussed between the four coders.

The total quantitative term production score was 28, while the total spatial term production score was 19. Each was transformed into a percentage of correct responses. The task had a strong internal consistency with a high Cronbach’s alpha (α = .870).

Results

Statistical analyses were computed using IMB SPSS Statistics 28.0 computer software. A p-value ≤ .05 was considered significant. We performed two analyses (respectively on the understanding of the mathematical vocabulary task and on the production of the mathematical vocabulary task) to answer the three research questions. In particular, we were looking for the presence of (1) a grade level effect, a term type effect, and their interaction to answer the Research Question 1; (2) a school environment effect to answer the Research Question 2; and (3) an interaction between the school environment and the grade level to respond to the Research Question 3. Appendix A presents the mean and standard deviation for each term of the understanding and production of mathematical vocabulary tasks, by grade level and school environment. Because we did not conduct a power analysis before the study, a sensitivity analysis was conducted with G*power: With our sample and our analysis design, we could have gotten a size effect of 1.13.

Results on the Understanding of Mathematical Vocabulary Task

First, we performed a 3(Grade level: 1, 2, 3) x 2(School environment: regular, REP+) x2(Term: quantitative, spatial) ANOVA on the mathematical vocabulary understanding score. Table 1 indicates descriptive analyses (see also Figure 3). The analysis revealed a significant grade level effect, $F(2,296) = 59.648$, $p < .001$, $\eta_p^2 = .287$. The post-hoc analysis (with Bonferroni correction) showed that children in Grade Level 1 were lower than children in Grade Level 2 ($p < .001$), who were lower than those in Grade Level 3 ($p = .001$). Second, a significant school environment effect was observed, $F(1,296) = 19.417$, $p < .001$, $\eta_p^2 = .062$, revealing that children from REP+ schools had lower scores than those from regular schools. The term effect was marginal, $F(1,296) = 3.416$, $p = .066$, $\eta_p^2 = .011$, but the interaction between term and grade level was significant, $F(2,296) = 3.033$, $p = .050$, $\eta_p^2 = .020$. The post-hoc analysis (with Bonferroni correction) showed that children in Grade Level 1 had lower scores in understanding quantitative than spatial terms ($p = .007$), whereas there was no difference for children according to term type in Grade Level 2 ($p = .535$) and in Grade Level 3 ($p = .609$). No other interaction was significant.

Table 1

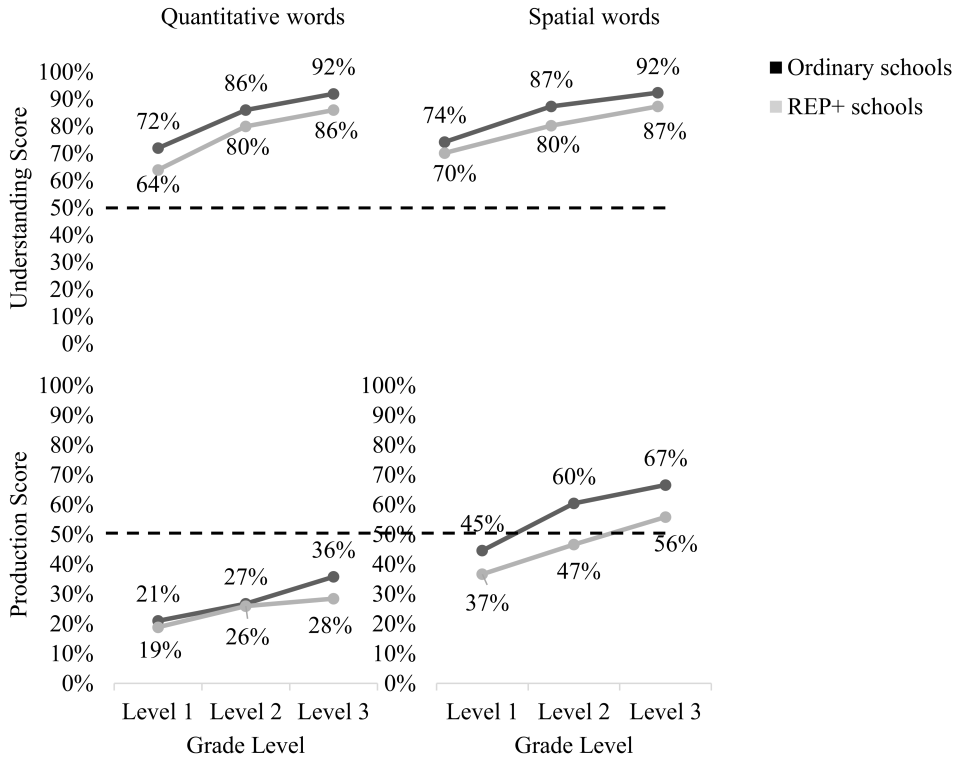
Proportion of Correct Responses (Mean, SD) on the Task of Mathematical Vocabulary Understanding in Function of Grade Level, School Environment, and Mathematical Terms

	Grade Level								
	1			**2**			**3**		
	School environment			**School environment**			**School environment**		
Type of terms	**Regular (*n* = 55)**	**REP+ (*n* = 27)**	**Total (*n* = 82)**	**Regular (*n* = 58)**	**REP+ (*n* = 44)**	**Total (*n* = 102)**	**Regular (*n* = 72)**	**REP+ (*n* = 46)**	**Total (*n* = 118)**
Quantitative terms	.72 (.16)	.64 (.15)	.69 (.16)	.86 (.11)	.80 (.14)	.84 (.13)	.92 (.07)	.86 (12)	.86 (.12)
Spatial terms	.74 (.16)	.70 (16)	.73 (.16)	.87 (.11)	.80 (.13)	.84 (.12)	.92 (.08)	.87 (.13)	.86 (.13)

Note. Across grade levels and school environments, Levene's test for the Quantitative Understanding Score: $F(5,299) = 4.965$, $p < .001$; Levene's test for the Spatial Understanding Score: $F(5,296) = 7.825$, $p < .001$. Four children did not complete the *C-MathéMOTiques* task.

Figure 3

Percentage of Correct Responses on the Task of Mathematical Vocabulary Production and Understanding in Function of Grade Level, School Environment, and Mathematical Terms



Note. The dotted line indicates the 50% random.

The lowest score was obtained on the quantitative term understanding by children schooled in Grade Level 1 from REP+ (.64). A supplement analysis was thus performed to investigate if this performance was above the chance level (50% of success). A *t-test* was performed on the quantitative mathematical vocabulary understanding score. Results showed that the performance was significantly different than chance level, $t(27) = 6.53$, $p < .001$.

Results on the Production of Mathematical Vocabulary Task

Second, we performed a 3(Grade level: 1, 2, 3) x 2(School environment: regular, REP+) x2(Term: quantitative, spatial) ANOVA on the mathematical vocabulary production score. Table 2 indicates descriptive analyses (see also Figure 3). The analysis revealed a signifi-

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cant grade level effect, $F(2,296) = 43.625$, $p < .001$, $\eta_p^2 = .228$. The post-hoc analysis (with Bonferroni correction) showed that children in Grade Level 1 produced fewer correct terms than those in Grade Level 2 ($p < .001$), who produced fewer correct terms than those in Grade Level 3 ($p = .001$). Second, a significant school environment effect was observed, $F(1,296) = 26.012$, $p < .001$, $\eta_p^2 = .081$, revealing that children from REP+ schools produced fewer correct terms than those from regular schools. The term effect was also significant, $F(1,296) = 924.044$, $p < .001$, $\eta_p^2 = .757$, revealing that children produced more correct spatial terms than correct quantitative terms.

Table 2

Proportion of Correct Responses (Mean, SD) on the Task of Mathematical Vocabulary Production in Function of Grade Level, School Environment, and Mathematical Terms

	Grade Level								
	1			2			3		
	School environment			School environment			School environment		
Type of terms	**Regular (*n* = 56)**	**REP+ (*n* = 29)**	**Total (*n* = 85)**	**Regular (*n* = 58)**	**REP+ (*n* = 44)**	**Total (*n* = 102)**	**Regular (*n* = 73)**	**REP+ (*n* = 46)**	**Total (*n* = 119)**
Quantitative terms	.21 (.09)	.19 (.08)	.20 (.09)	.27 (.10)	.26 (.09)	.26 (.10)	.36 (.11)	.28 (.11)	.33 (.12)
Spatial terms	.45 (.18)	.37 (.17)	.42 (.18)	.60 (.15)	.47 (.19)	.55 (.18)	.67 (.14)	.56 (.20)	.62 (.17)

Note. Across grade levels and school environments, Levene's test for the Quantitative Production Score: $F(5,299) = .986$, $p = .427$; Levene's test for the Spatial Production Score: $F(5,296) = 1.372$, $p = .235$.

Also, the interaction between term and grade level was significant, $F(2,296) = 8.374$, $p < .001$, $\eta_p^2 = .054$, the interaction between term and school environment was significant, $F(1,296) = 18.839$, $p < .001$, $\eta_p^2 = .060$, but the interaction between grade level and school environment was not significant, $F(2,296) = 0.692$, $p = .501$. These two significant interactions must be interpreted in light of the significant three-way (term by grade level by school environment) interaction, $F(2,296) = 3.978$, $p = .020$, $\eta_p^2 = .026$. To find the source of the interaction, we ran three univariate analyses of variance to test the term by school environment interactions at each grade level.

For Grade Level 1, there was a significant main effect of the term, $F(1,81) = 146.434$, $p < .001$, $\eta_p^2 = .644$, a marginal main effect of the school environment, $F(1,81) = 3.703$, $p = .058$, $\eta_p^2 = .044$, and no two-way interaction, $F(1,81) = 2.553$, $p = .114$. Whatever the school environment, children in Grade Level 1 produced more correct spatial terms than correct quantitative terms. For Grade Level 2, there was a significant main effect of the term, $F(1,99) = 358.346$, $p < .001$, $\eta_p^2 = .784$, a significant main effect of the school environment, $F(1,99) = 9.555$, $p = .003$, $\eta_p^2 = .088$, and a significant two-way interaction, $F(1,99) = 22.358$, $p < .001$, $\eta_p^2 = .184$. The post-hoc analysis (with Bonferroni correction) showed that children in Grade Level 2 from REP+ schools produced as many correct quantitative terms as those in regular schools (p = .859) but fewer correct spatial terms than those in regular schools (p < .001). For Grade Level 3, there was a significant main effect of the term, $F(1,116) = 533.993$, $p < .001$, $\eta_p^2 = .822$, a significant main effect of the school environment, $F(1,116) = 16.621$, $p < .001$, $\eta_p^2 = .125$, but no two-way interaction, $F(1,116) = 1.362$, $p = .246$. Whatever the school environment, children in Grade Level 3 produced more correct spatial terms than correct quantitative terms. Whatever the type of term, children in Grade Level 3 from REP+ schools produced fewer correct terms than those from regular schools.

Finally, we performed a 3(Grade level: 1, 2, 3) x 2(School environment: regular, REP+) x2(Term: quantitative, spatial) ANOVA on the mathematical vocabulary production concept score. Table 3 indicates descriptive analyses. The analysis revealed a significant grade level effect, $F(2,296) = 49.410$, $p < .001$, $\eta_p^2 = .250$. The post-hoc analysis (with Bonferroni correction) showed that children in Grade Level 1 produced fewer correct concept terms than those in Grade Level 2 (p < .001), who produced fewer correct concept terms than those in Grade Level 3 (p < .001). Second, a significant school environment effect was observed, $F(1,296) = 21.594$, $p < .001$, $\eta_p^2 = .068$, revealing that children from REP+ schools produced fewer correct concept terms than those from regular schools. The term effect was also significant, $F(1,296) = 35.599$, $p < .001$, $\eta_p^2 = .107$, revealing that children produced more correct spatial concept terms than correct quantitative concept terms.

Table 3

Proportion of Correct Concept Responses (Mean, SD) on the Task of Mathematical Vocabulary Production in Function of Grade Level, School Environment, and Mathematical Terms

	Grade Level								
	1			2			3		
	School environment			School environment			School environment		
Type of terms	**Regular (n = 56)**	**REP+ (n = 29)**	**Total (n = 85)**	**Regular (n = 58)**	**REP+ (n = 44)**	**Total (n = 102)**	**Regular (n = 73)**	**REP+ (n = 46)**	**Total (n = 119)**
Quantitative terms	.71 (.17)	.62 (.20)	.68 (.19)	.80 (.09)	.76 (.15)	.79 (.12)	.82 (.17)	.80 (.14)	.81 (.16)
Spatial terms	.62 (.16)	.54 (.18)	.60 (.17)	.78 (.11)	.67 (.15)	.73 (.14)	.84 (.11)	.76 (.16)	.81 (.14)

Also, the interaction between term and grade level was significant, $F(2,296) = 4.922$, $p = .008$, $\eta_p^2 = .032$, the interaction between term and school environment was significant, $F(1,296) = 4.233$, $p = .041$, $\eta_p^2 = .014$, but the interaction between grade level and school environment and that between grade level and school environment and term were not significant, $F(2,296) = 0.455$, $p = .635$ and $F(2,296) = 1.815$, $p = .165$ respectively.

Relative to the interaction between term and grade level, the analysis showed that, for quantitative concept terms, children in Grade Level 1 produced fewer correct terms than those in Grade Level 2 ($p < .001$) and those in Grade Level 3 ($p < .001$), with no difference between Grade Level 2 and Grade Level 3 children ($p = .459$). For spatial concept terms, children in Grade Level 1 produced fewer correct concept terms than those in Grade Level 2 ($p < .001$), who produced fewer correct concept terms than those in Grade Level 3 ($p < .001$). Relative to the interaction between term and school environment, the analysis showed that children from REP+ schools produced fewer correct concept terms than those from regular schools, but the difference was larger for spatial than quantitative concept terms.

Discussion

Interpretation of Results

The first research question was to assess whether children would show differences in their understanding and production of quantitative and spatial mathematical vocabulary in the same way from 3-4 (Grade Level 1) to 5-6 years old (Grade Level 3; Hypothesis 1). In sum, we showed that children in Grade Level 1 were lower than those in Grade Level 2, who were lower than those in Grade Level 3, for both understanding and production. As expected, children in Grade Level 1 had a lower understanding of quantitative than spatial terms, whereas there was no difference for children in Grade Levels 2 and 3. The development of quantitative and spatial terms did not occur concurrently. Spatial term understanding seemed to be acquired more easily at home before starting school than quantitative terms. The school curriculum, which focuses on number skills, was designed to help children improve their quantitative term understanding to reduce the gap with the spatial terms. Concerning production, children in Grade Level 1 were lower than those in Grade Level 2, who were lower than those in Grade Level 3 for both quantitative and spatial terms. Furthermore, in each grade level, children produced fewer quantitative than spatial terms, so the school did not make children increase their quantitative term production and catch up with their spatial term production.

Concerning understanding, our analysis confirmed that young children aged 3 years old (Grade Level 1) already understand some mathematical terms. Even young children in Grade Level 1 in REP+ schools obtained above chance-level scores, demonstrating that they started school with an understanding of some mathematical vocabulary acquired at home. However, our results showed that children in Grade Level 1 had a lower understanding of quantitative than spatial terms, whereas there was no difference according to term type in Grade Level 2. Our results were thus in line with Masek et al. (2024), who showed that parents spontaneously produced more spatial than quantitative terms and that 2-3-year-old children's understanding was related to their parents' math talk. They thus suggest that quantitative terms need more time and practice to be learned and understood, possibly because they are more math-specific (Kirchoff, 1981). However, since children in Grade Level 1 were tested between February and May, their mathematical vocabulary knowledge cannot be purely attributed to home environment differences, as early schooling exposure could also play a role. Future studies should collect data from children immediately before or at the very onset of formal schooling.

Concerning the production of mathematical terms, our analysis, however, showed that young children, even those schooled in Grade Level 3, were very low in our production task, whatever the type of terms – quantitative or spatial. They indeed arrive at school and finish preschool without knowledge of the exact mathematical term production, which would require more time and practice. In particular, our study showed that young children especially started preschool with very low quantitative term production. A possible explanation may be that, since children's production was related to their parents' production of mathematical vocabulary during play sessions (Masek et al., 2024), parents would produce more spatial than quantitative terms during play sessions, such as construction play. While young children experienced difficulties producing exact mathematical terms, it is possible to think that young children could express the concept differently, but they did not have the targeted term. The results indeed showed that children's knowledge was better when we considered semantically equivalent terms as correct.

We observed that children, regardless of the grade level, obtained low scores in producing exact mathematical terms; however, the scores did not indicate particularly low performance in understanding, since all scores were above chance level in mathematical vocabulary understanding. The two tasks were very different in their form (a forced choice in the understanding task but an open-ended one in the production score), so that did not allow us to compare directly their score. However, the fact that scores were low in production is consistent with other research, which even showed that children had more difficulty in production than in comprehension, and is well aligned with many previous studies about the development of general vocabulary (Bouchard, 2019; Papalia & Martorell, 2018) that showed that children understand more terms than they produce. Taken together, relatively to our first research question, our study suggests that children start school (at 3 years old) with an understanding of some mathematical vocabulary acquired at home, they finish preschool with a better understanding, but they still have very limited mathematical vocabulary production knowledge when they must produce an exact word. However, when we consider the production of semantically equivalent terms, children start school with limited competencies to express some mathematical ideas, and they finish preschool with better concept production.

Second, we aimed to investigate the effect of the school environment on children's understanding and production of mathematical vocabulary (Hypothesis 2). We showed that children from REP+ (the lowest socioeconomic environment) had lower scores than children from regular schools (moderate-to-high socioeconomic environment) in understanding and producing mathematical vocabulary. It could be that a low socioeconomic environment restricts the children's opportunities to understand and produce quantitative and spatial mathematical vocabulary. One plausible explanation could be that children from low socioeconomic environments could be exposed to a less lexically rich and less stimulating home math environment, which includes all math-related activities, attitudes, beliefs, expectations, and utterances in the home (Daucourt et al., 2021), at least in the school language, but also in every place outside of formal school settings such as play settings or at the home of friends for example. Through verbal interaction with adults, children learn to use language and specific vocabulary. The home numeracy environment causally influenced children's numerical development (Girard et al., 2025). Then, through social interactions with their caregivers, children learn about mathematics. The math talk used by parents is related to the 2-3-year-old children's math talk and mathematics vocabulary understanding (Masek et al., 2024). This speculation needs to be verified. Our results about the mathematical vocabulary knowledge (understanding and production) being lower in children from a low socioeconomic school environment than in children from an ordinary school could be an explanation for the disparities in mathematics skills observed later (Duncan & Magnuson, 2011; Gjicali et al., 2019; Johnson et al., 2022; Jordan et al., 1994; Liu et al., 2022). This assumption needs to be investigated in future studies.

An exception was observed in the production of quantitative terms: Children in Grade Levels 1 and 2 from REP+ did not differ from those from regular schools, but this result can be explained by the very low scores (from 19 to 27% of success only): Whatever the school environment, young children did not produce correct mathematical terms. This result may be explained either by spatial language being easier to acquire than quantitative language, or by parental math talk focusing more on spatial than on quantitative terms (Swirbul et al., 2024). Future studies should verify this assumption.

Our last research question was to study whether the school environment had a different impact on children's understanding and production of mathematical vocabulary as a function of the grade level (Hypothesis 3). Our results showed that children from REP+ (the lowest socioeconomic environment) performed lower than children from regular schools (moderate-to-high socioeconomic environment) in understanding and producing mathematical vocabulary. However, the difference in understanding of mathematical vocabulary between children from REP+ and those from regular schools did not appear to decrease as grade level increased. Moreover, a difference in the production of mathematical vocabulary between children from REP+ and those from regular schools appeared after two years of schooling. Although young children schooled in Grade Level 1 from REP+ schools obtained the lowest score in understanding, this performance was above the chance level and showed that they started school with some understanding of mathematical vocabulary acquired at home. After three years of schooling, children schooled in Grade Level 3 from regular schools obtained the highest score in production. Nonetheless, they finished preschool with little knowledge of producing exact terms of mathematical vocabulary. The developmental progression observed (relative to Question 1) did not vary according to socioeconomic background. In fact, in Grade Level 3, all children progressed equally, both in regular school and low socioeconomic environments.

Our results were congruent with some previous research, such as Jordan et al. (1994) and Berger et al. (2025) on the one hand, and such as Meir and Armon-Lotem (2017) and Berger et al. (2025) on the other hand, respectively showing a socioeconomic environment impact on general mathematical abilities and language acquisition. Our results were also in line with the unique previous studies interested in the impact of the socioeconomic environment on children's mathematical vocabulary understanding (Bleses et al., 2023; Purpura & Reid, 2016), and they bring new contributions to mathematical vocabulary knowledge. In France, there is a priority education policy aimed at reducing the impact of social inequalities on performance at school. Additional resources are allocated to schools in disadvantaged areas, such as a lower number of students in the classrooms and additional consultation and training times for teachers (Ministère de l'Education Nationale, 2014). However, the socioeconomic environment had a strong impact on children's mathematical vocabulary understanding and production, and schooling was not able to reduce inequalities. Our study, therefore, highlighted that young children in French REP+ schools statistically have less knowledge of mathematical vocabulary, namely a lower understanding and a lower production of terms, and that teachers from French REP+ schools must deal with that fact. We thus failed to show that schooling reduced inequalities. We may therefore interpret that the socioeconomic environment had a strong impact on children's mathematical vocabulary understanding and production, and that schooling was not able to reduce the inequalities.

Limitations

The most important limitation in this study was related to the participants. First, the socioeconomic environment was considered as a binary variable: Either the child was categorized as schooled in a low socioeconomic environment if he or she was schooled in a REP+ school, or as schooled in a moderate-to-high socioeconomic environment if he or she was schooled in a regular school. Instead of this measure, we could have used the family income or the highest educational degree of the mothers, for example. We chose the school indicator because it revealed the reality of the students, school by school, and because we investigated whether the REP+ schools, with the resources at their disposal, may reduce the impact of social inequalities on mathematical vocabulary at school. Future studies should explore the effects of other socioeconomic environmental indicators.

Second, we did not control the eventual impact of bilingualism in classrooms. One plausible explanation for the lower mathematical vocabulary knowledge in schools in a low socioeconomic environment could be the preponderance of children whose home language was different from the school language. There was reason to believe that the difference in the proportion of first-language learners and second-language learners in each environment (regular vs. REP+ schools) could explain the impact of the type of school reported on children's mathematical vocabulary knowledge and acquisition. Indeed, an advantage for 5-year-old first-language learners, compared to second-language learners, has recently been demonstrated in quantitative and spatial mathematical language tasks (Turan & De Smedt, 2024). However, this later study did not control the socioeconomic environment. In future studies, we will explore whether the socioeconomic environment and linguistic status of learning would impact children's understanding and production of mathematical vocabulary (see Berger et al., 2026).

Another limitation was related to the order of the tasks: for each child, the production task preceded the understanding task. We made this choice to avoid the effect of priming the production task with the understanding task. Indeed, in the understanding task, the target word was pronounced by the experimenter, then the child selected the corresponding picture. This could serve as a prime and thus ease later retrieval in the production task. By starting with the production task, we avoided this problem, especially since we carefully did not give any corrective feedback during the task. The target word was therefore never uttered by the experimenter.

Finally, our study was a transversal design that supported a comparison of three grade levels in two school environments. Future studies, however, should investigate mathematical vocabulary development in a longitudinal study. Following young 3-year-old children (Grade Level 1) until they are 5-6 years old (Grade Level 3) would allow researchers to study the same variables (age/grade level and school environment) in considering the specific functioning of each child and grasping differential aspects in the trajectory of each child.

Strengths and Contributions

Our study also had strengths. First, we collected developmental data on not only mathematical term understanding, as many previous studies, but also on mathematical term production. It represents a large contribution to our knowledge that allows us to observe the developmental trajectories of the two aspects of mathematical term knowledge.

Second, the mathematical term understanding and production has been collected in a large sample (N = 306) and in the whole French preschool/kindergarten system from 3 to 6 years old. It is the first study to explore as largely French young children's mathematical term understanding and production, so for the first time, researchers may dispose of a valid task to assess French young children's mathematical term understanding. The internal consistency of each task was high. Furthermore, the *C-MathéMOTiques* and

P-MathéMOTiques tasks (anybody can contact the authors to get the task) can distinguish mathematical term understanding and production according to the school environment, revealing construct validity.

Conclusion

Our study aimed at understanding how mathematical vocabulary develops in the early ages and, in particular, to assess whether the school environment would have an impact on the beginning (3-4 years old, Grade Level 1) to the end (5-6 years old, Grade Level 3) of preschool children's quantitative and spatial mathematical vocabulary understanding and production knowledge. Taken together, our results showed that children started school (at 3 years old) with a sense of some mathematical vocabulary acquired at home, and they finished preschool with a better understanding. Concerning production, they still had limited mathematical vocabulary knowledge when they were required to produce an exact term, even at the end of preschool. However, when we considered the production of semantically equivalent terms, children started school with limited competencies to express some mathematical ideas, and they finished preschool with better concept production. More importantly, children from the lowest socioeconomic environment had lower scores than children from regular schools (moderate-to-high socioeconomic environment) in understanding and producing mathematical vocabulary, and the difference did not appear to decrease as grade level increased. As a result, the study highlighted the need for teaching mathematical vocabulary, especially to children from the lowest socioeconomic environment. The question of what form such instruction might take also came up. We are now working on an intervention study that focuses on these aspects.

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Competing Interests: The authors declare that no competing interests exist.

Ethics Statement: The project had been approved by the ethics Committee of the Université Savoie Mont Blanc.

Data Availability: The research data for this study is publicly available (see Lafay et al., 2026S).

Supplementary Materials

The two MathéMOTiques tasks and the data are deposited in the OSF link (for access, see Lafay et al., 2026S).

Index of Supplementary Materials

Lafay, A., Berger, C., & Angonin, S. (2026S). *MathéMOTiques* [Research data and materials]. OSF. https://osf.io/jxweq/

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Appendix A

Table A1

Mean (Standard Deviation) for Each Term of the Understanding of Mathematical Vocabulary Tasks, by Grade Level and School Environment

	Grade Level					
	1 (3-4 years old)		2 (preschool, 4-5 years old)		3 (kindergarten, 5-6 years old)	
	School environment		School environment		School environment	
Terms	Regular (*n* = 56)	REP+ (*n* = 29)	Regular (*n* = 58)	REP+ (*n* = 44)	Regular (*n* = 73)	REP+ (*n* = 46)
Quantitative Terms						
Grand	.96 (.19)	.97 (.19)	1.00 (.00)	1.00 (.00)	1.00 (.00)	1.00 (.00)
Pas assez	.89 (.31)	.79 (.41)	.93 (.26)	.84 (.37)	1.00 (.00)	.96 (.21)
Compléter	.45 (.50)	.28 (.45)	.81 (.40)	.59 (.50)	.86 (.35)	.74 (.44)
Compter	.77 (.43)	.90 (.31)	.93 (.26)	.91 (.29)	.96 (.20)	.93 (.25)
Petit	.98 (.13)	.86 (.35)	.98 (.13)	.98 (.15)	1.00 (.00)	1.00 (.00)
Un peu	.82 (.39)	.76 (.44)	.97 (.18)	.89 (.32)	.94 (.23)	.91 (.28)
Ajouter	.67 (.47)	.69 (.47)	.93 (.26)	.86 (.35)	.96 (.20)	.87 (.34)
Trop	.95 (.23)	.83 (.38)	.98 (.13)	.93 (.25)	1.00 (.00)	.98 (.15)
Nombre	.53 (.50)	.48 (.51)	.86 (.13)	.66 (.48)	.96 (.20)	.89 (.31)
Encore	.93 (.26)	.86 (.35)	.98 (.13)	1.00 (.00)	.99 (.12)	1.00 (.00)
Plus	.91 (.29)	.83 (.38)	.97 (.18)	.91 (.29)	.99 (.12)	.91 (.28)
Beaucoup	.95 (.23)	.97 (.19)	1.00 (.00)	1.00 (.00)	1.00 (0.00)	.96 (.21)
Enlever	.75 (.44)	.61 (.50)	.91 (.28)	.84 (.37)	.92 (.28)	.91 (.28)
Moins	.75 (.44)	.57 (.50)	.95 (.22)	.82 (.39)	.99 (.12)	.93 (.25)
Tous	.75 (.44)	.64 (.49)	.97 (.18)	.91 (.29)	.94 (.23)	.91 (.28)
Moyen	.65 (.48)	.57 (.50)	.91 (.28)	.77 (.42)	.96 (.20)	.93 (.25)
Partager	.56 (.50)	.36 (.49)	.53 (.50)	.70 (.46)	.86 (.35)	.74 (.44)
Assez	.64 (.49)	.61 (.50)	.84 (.37)	.75 (.44)	.96 (.20)	.70 (.47)
Plus que	.80 (.40)	.85 (.36)	.98 (.13)	.98 (.15)	.99 (.12)	.93 (.25)
Manquer	.80 (.40)	.67 (.48)	.95 (.22)	.70 (.46)	.92 (.28)	.87 (.34)
Peu	.82 (.39)	.70 (.47)	.91 (.28)	.89 (.32)	.92 (.28)	.87 (.34)
Moins que	.67 (.47)	.48 (.51)	.79 (.41)	.57 (.50)	.90 (.30)	.85 (.36)
Chacun	.62 (.49)	.59 (.50)	.78 (.42)	.82 (.39)	.94 (.23)	.89 (.31)
Retirer	.65 (.48)	.59 (.50)	.74 (.44)	.73 (.45)	.83 (.38)	.63 (.49)
Dizaine	.51 (.50)	.56 (.51)	.84 (.37)	.84 (.37)	.97 (.17)	.89 (.31)
Egal	.42 (.50)	.30 (.47)	.66 (.48)	.52 (.51)	.76 (.43)	.78 (.42)
Autant	.25 (.44)	.15 (.36)	.10 (.31)	.25 (.44)	.25 (.44)	.33 (.47)
Additionner	.60 (.49)	.70 (.47)	.78 (.42)	.89 (.32)	.90 (.30)	.83 (.38)
Spatial terms						
En haut	.96 (.19)	.93 (.27)	1.00 (.00)	1.00 (.00)	1.00 (0.00)	.98 (.15)
Premier	.71 (.46)	.74 (.45)	.88 (.33)	.86 (.35)	.99 (.12)	.96 (.21)
En-dessous	.69 (.47)	.56 (.51)	.91 (.28)	.66 (.48)	.93 (.26)	.78 (.43)
Derrière	.91 (.29)	.93 (.27)	.98 (.13)	.91 (.29)	1.00 (.00)	.96 (.21)
Dedans	1.00 (.00)	1.00 (.00)	.98 (.13)	.98 (.15)	1.00 (.00)	1.00 (.00)
Devant	.75 (.44)	.52 (.51)	.97 (.18)	.91 (.29)	.93 (.26)	.87 (.34)
Sous	.89 (.31)	.89 (.32)	.95 (.22)	.84 (.37)	.94 (.23)	.91 (.28)
Dernier	.47 (.50)	.37 (.49)	.79 (.41)	.64 (.49)	.99 (.12)	.85 (.36)
En bas	.87 (.34)	.81 (.40)	1.00 (.00)	.95 (.21)	1.00 (.00)	.98 (.15)
Au-dessus	.76 (.43)	.74 (.45)	.84 (.37)	.73 (.45)	.92 (.28)	.72 (.46)
Après	.62 (.49)	.63 (.49)	.84 (.37)	.61 (.49)	.89 (.32)	.83 (.38)

Terms	Grade Level 1 (3-4 years old) School environment Regular (*n* = 56)	REP+ (*n* = 29)	2 (preschool, 4-5 years old) School environment Regular (*n* = 58)	REP+ (*n* = 44)	3 (kindergarten, 5-6 years old) School environment Regular (*n* = 73)	REP+ (*n* = 46)
Dans	.96 (.19)	.74 (.45)	1.00 (.00)	.95 (.21)	1.00 (.00)	.93 (.25)
Sur	.95 (.23)	.63 (.49)	.97 (.18)	.95 (.21)	.97 (.20)	.89 (.31)
Dehors	.95 (.23)	.93 (.27)	1.00 (.00)	.95 (.21)	1.00 (.00)	.96 (.21)
Avant	.75 (.44)	.78 (.42)	.91 (.28)	.82 (.39)	.86 (.35)	.80 (.40)
Entre	.36 (.49)	.52 (.51)	.69 (.47)	.55 (.50)	.89 (.32)	.80 (.40)
A gauche	.42 (.50)	.59 (.50)	.41 (.50)	.59 (.50)	.57 (.50)	.54 (.50)
Position	.64 (.49)	.52 (.51)	.90 (.31)	.86 (.35)	.94 (.23)	.91 (.28)
A droite	.44 (.50)	.56 (.51)	.57 (.50)	.48 (.51)	.64 (.48)	.59 (.50)

Note. Dark gray: ≥ .75; Medium gray: ≥ .50 and < .75; Light gray: < .50.

Table A2

Mean and Standard Deviation for Each Term of the Production of Mathematical Vocabulary Tasks, by Grade Level and School Environment

Terms	Grade Level 1 (3-4 years old) School environment Regular (*n* = 56)	REP+ (*n* = 29)	2 (preschool, 4-5 years old) School environment Regular (*n* = 58)	REP+ (*n* = 44)	3 (kindergarten, 5-6 years old) School environment Regular (*n* = 73)	REP+ (*n* = 46)
Quantitative terms						
Enlever	.16 (.37)	.07 (.26)	.43 (.50)	.36 (.49)	.64 (.48)	.50 (.51)
Compter	.23 (.43)	.32 (.48)	.45 (.50)	.50 (.51)	.74 (.44)	.67 (.47)
Trop	.04 (.19)	.07 (.26)	.16 (.37)	.02 (.15)	.31 (.46)	.09 (.28)
Ajouter	.07 (.26)	.00 (.00)	.26 (.44)	.11 (.32)	.42 (.50)	.20 (.40)
Tous	.00 (.00)	.00 (.00)	.03 (.18)	.05 (.21)	.14 (.35)	.02 (.15)
Un peu	.34 (.48)	.36 (.49)	.16 (.37)	.34 (.48)	.17 (.38)	.09 (.28)
Moins	.18 (.39)	.00 (.00)	.45 (.50)	.11 (.32)	.64 (.48)	.39 (.49)
Nombre	.05 (.23)	.00 (.00)	.02 (.13)	.05 (.21)	.33 (.47)	.07 (.25)
Pas assez	.13 (.33)	.07 (.26)	.09 (.28)	.07 (.25)	.17 (.38)	.13 (.34)
Grand	.55 (.50)	.75 (.44)	.66 (.48)	.91 (.29)	.75 (.44)	.83 (.38)
Moyen	.64 (.48)	.43 (.50)	.88 (.33)	.80 (.41)	.96 (.20)	.93 (.25)
Petit	.87 (.34)	.86 (.36)	.76 (.43)	.93 (.25)	.79 (.41)	.72 (.46)
Beaucoup	.64 (.49)	.54 (.51)	.67 (.47)	.64 (.49)	.67 (.47)	.50 (.51)
Plus	.15 (.36)	.07 (.26)	.31 (.47)	.14 (.35)	.56 (.50)	.39 (.49)
Encore	.35 (.48)	.18 (.39)	.28 (.45)	.16 (.37)	.31 (.46)	.24 (.43)
Manquer	.33 (.47)	.21 (.42)	.45 (.50)	.41 (.50)	.58 (.50)	.48 (.51)
Partager	.00 (.00)	.00 (.00)	.05 (.22)	.02 (.15)	.01 (.12)	.02 (.15)
Peu	.56 (.50)	.71 (.46)	.45 (.50)	.74 (.44)	.39 (.49)	.54 (.50)
Retirer	.00 (.00)	.04 (.19)	.00 (.00)	.05 (.15)	.03 (.17)	.00 (.00)
Autant	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.07 (.26)	.02 (.15)

Terms	Grade Level: 1 (3-4 years old), School environment: Regular (*n* = 56)	REP+ (*n* = 29)	2 (preschool, 4-5 years old), School environment: Regular (*n* = 58)	REP+ (*n* = 44)	3 (kindergarten, 5-6 years old), School environment: Regular (*n* = 73)	REP+ (*n* = 46)
Chacun	.02 (.13)	.00 (.00)	.07 (.26)	.09 (.29)	.17 (.38)	.09 (.28)
Additionner	.00 (.00)	.00 (.00)	.02 (.13)	.00 (.00)	.00 (.00)	.02 (.15)
Egal	.00 (.00)	.04 (.19)	.05 (.13)	.00 (.00)	.08 (.28)	.09 (.28)
Dizaine	.00 (.00)	.00 (.00)	.02 (.13)	.00 (.00)	.14 (.35)	.09 (.28)
Spatial terms						
Haut	.91 (.29)	.89 (.31)	.97 (.18)	.93 (.26)	.97 (.17)	.93 (.25)
Devant	.64 (.49)	.61 (.50)	.97 (.18)	.74 (.44)	.96 (.20)	.83 (.38)
Dehors	.89 (.31)	.75 (.44)	.88 (.33)	.84 (.37)	.85 (.26)	.78 (.42)
Bas	.78 (.42)	.64 (.49)	.93 (.26)	.86 (.35)	.99 (.12)	.87 (.34)
Sous	.42 (.50)	.36 (.49)	.34 (.48)	.35 (.48)	.51 (.50)	.30 (.47)
En-dessous	.36 (.49)	.32 (.48)	.53 (.50)	.35 (.48)	.56 (.50)	.46 (.50)
Sur	.58 (.50)	.32 (.48)	.62 (.49)	.56 (.50)	.61 (.49)	.48 (.51)
Premier	.25 (.44)	.18 (.39)	.66 (.48)	.56 (.50)	.86 (.35)	.83 (.38)
Avant	.02 (.13)	.07 (.26)	.14 (.35)	.07 (.26)	.04 (.20)	.15 (.36)
Derrière	.78 (.42)	.54 (.51)	.95 (.22)	.74 (.44)	.97 (.17)	.87 (.34)
Au-dessus	.44 (.50)	.32 (.48)	.64 (.48)	.42 (.50)	.74 (.44)	.52 (.51)
Dernier	.24 (.43)	.29 (.46)	.74 (.44)	.56 (.50)	.93 (.26)	.83 (.38)
Dans	.75 (.44)	.57 (.50)	.83 (.38)	.63 (.49)	.76 (.43)	.72 (.46)
Après	.07 (.26)	.00 (.00)	.05 (.22)	.00 (.00)	.10 (.30)	.02 (.15)
Entre	.15 (.36)	.00 (.00)	.05 (.22)	.02 (.15)	.21 (.41)	.24 (.43)
A droite	.35 (.48)	.43 (.50)	.72 (.45)	.44 (.50)	.86 (.35)	.63 (.49)
Position	.07 (.26)	.00 (.00)	.17 (.38)	.12 (.32)	.39 (.49)	.22 (.42)
A gauche	.44 (.50)	.43 (.50)	.76 (.43)	.44 (.50)	.82 (.39)	.63 (.49)

Note. Dark gray: ≥ .75; Medium gray: ≥ .50 and < .75; Light gray: < .50.

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