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ABSTRACT

Gender Differences in Children's Extracurricular Activities: Japanese Parental Preference for STEM Activities for Sons*

Using original survey data from parents of children in kindergarten through junior high school in Tokyo, Japan, we find that parents exhibit stronger preferences for sons over daughters to participate in extracurricular STEM activities, with the gender gap widening as children age. Parents aspiring for their children to pursue STEM degrees prioritize science classes more, a preference more often directed toward boys. These gendered differences affect children's early exposure to science. Since Japanese students choose between science and humanities tracks by eleventh grade, early disparities may limit girls' opportunities. Promoting equal STEM access is crucial to reducing these gender gaps.

JEL Classification: A21, I24, J13, J16
Keywords: science learning, STEM, gender, Japan

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1 Introduction

Parents play a crucial role in shaping their children's future through decisions that significantly impact their development (Rozek et al., 2017; Doepke, Sorrenti, and Zilibotti 2019; Carlana and Corno, 2024). Extracurricular activities for elementary school children, often chosen and funded by parents, can influence their educational paths, including their likelihood of pursuing a degree in science, technology, engineering, and mathematics (STEM) in college. If parents' decisions regarding STEM-related extracurricular activities are influenced by their child's gender, then gender disparities in STEM-degree attainment may have roots in childhood—since early exposure to such activities is relevant for developing scientific aptitude (Microsoft, 2018; Thomas et al., 2020; Ennes et al., 2023). Understanding how and why parents choose specific extracurricular activities is crucial for addressing gender inequality and its intergenerational transmission.

Research shows that gender differences in mathematics test scores are smaller in early childhood but widen during middle to high school (Hyde et al., 2008; Penner and Paret, 2008; Fryer and Levitt, 2010; Lubienski et al., 2013; Ceci et al., 2014; Kahn and Ginther, 2017). This growing gap contributes to the underrepresentation of adult women in STEM fields. This problem is particularly pronounced in Japan, which has the lowest percentage of women with STEM degrees among OECD countries—only eighteen percent in 2021, compared to forty percent in the United States. Studies indicate that a key factor underlying this gender gap is the fact that parents' perceptions of their children's mathematical and scientific abilities shape their children's future interests and involvement in these subjects (Inoue, 2019; Jacobs and Bleeker, 2004; Wolter and Zollner, 2024). Another related factor is the extent to which parents in Japan encourage STEM activities for their sons more than for their daughters—an issue that has been understudied before this paper.

In this study, we investigate the types of extracurricular activities Japanese children participate in and how these activities differ between girls and boys, even within the same family. The data come from two surveys we conducted of parents with children from kindergarten to junior high school: one from the Tokyo metropolitan area and another focused on families with a child enrolled in extracurricular STEM activities. Our findings reveal that

parents' emphasis on early exposure to science is gender-biased. Parents who aspire for their children to pursue college majors in engineering or science or to obtain a graduate degree—who often focus more on boys for these goals—are more likely to enroll them in, or to prefer that they participate in, extracurricular STEM activities. Moreover, this gender preference for boys increases from early childhood through adolescence.

Such parental behaviors can shape children's aptitudes and performance in science, ultimately influencing their decision as to whether to pursue a STEM degree. According to the 2023 Trends in International Mathematics and Science Study (TIMSS), which assessed students in their fourth and eighth years of schooling, Japanese girls at both those ages were less likely than boys to express interest in studying science (National Institute for Educational Policy Research, 2024). This discrepancy may be influenced, at least in part, by differences in parental behaviors. Encouraging girls to participate in STEM activities from an early age is therefore essential for reducing future gender disparities in STEM fields. As Schiefer et al. (2021) found, extracurricular science activities enhance students' epistemic beliefs and increase their intrinsic motivation and perceived value of science—effects that are especially pronounced among girls. These findings suggest that such interventions can have a lasting impact in promoting girls' engagement with science and encouraging them to pursue STEM careers.

The paper is structured as follows. Section 2 describes the surveys that we conducted. Section 3 presents key findings on gender differences in participation in STEM activities. Section 4 reports estimates from family fixed-effect models on the determinants of participation and preference rankings in STEM activities. Section 5 provides the conclusion.

2 Surveys on Children's Participation in Extracurricular Activities

2.1 Survey Design

In November 2023, we conducted a survey of parents whose children were enrolled in science experiment or robotics/programming classes operated by a private tutoring company in the Tokyo metropolitan area.[1] The company provides (i) science classes in a lab setting and (ii)

[1] The tutoring school operates these STEM classes in Tokyo's twenty-three wards, as well as in the Northern Tama area of Tokyo and the nearby cities of Saitama, Yokohama, and Urayasu.

robotics/programming classes (referred to as "robotics classes") for children from kindergarten to junior high school. We sent approximately two thousand invitation emails to parents, and 388 responded by completing the online survey via SurveyMonkey.com. The survey gathered information on children's grade levels, extracurricular activities, and parents' aspirations for their children's education, including for college majors and degree attainment. These questions applied not only to the children enrolled in the classes, but also to up to three other children in the family. This design enabled us to estimate a family fixed-effects model. The survey also collected data on parental education and income. We refer to this sample as "the STEM Sample."

Given that families whose children participate in science or robotics classes may be *a priori* STEM-oriented, we considered a broader population. To achieve this, we conducted a similar survey through a survey company in January 2024. The participants, married parents residing in the Tokyo metropolitan area with at least one child between pre-kindergarten and junior high school, were recruited from the company's online panel and completed the survey online. Parents received modest incentives for completing the survey in the form of reward points, redeemable for online shopping. A total of 3114 respondents were collected. We refer to this sample as "the Tokyo Sample."

In both surveys, parents were asked to select the extracurricular activities their children are currently participating in or have previously participated in, based on the list in footnote 2 below.[2] This list is adapted from the Longitudinal Survey of Newborns in the 21st Century, conducted by Japan's Ministry of Labour and Welfare, which outlines common extracurricular activities for school-age children in Japan. We added (i) science and (ii) robotics/programming classes as STEM-related activities.[3]

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[2] The list of extracurricular activities is: Abacus, Art/Crafts, Calligraphy (including penmanship), Flower Arrangement (Ikebana)/Tea Ceremony, Foreign language conversation (Conversation in English or other foreign languages), Music (Piano, etc.), Private Tutoring, Robotics/Programming, Science Experiments, Sports, Ballet/Dance, Baseball/Softball, Gymnastics, Martial Arts (Kendo, Judo, etc.), Soccer, Swimming, Tennis, Tutoring Classes in school subjects, and Distance Education Course.

[3] Science and robotics classes are typically offered a 90-minute session twice a month, with monthly fees ranging from 11,000 to 15,000 yen (approximately US$70 to US$100). Sports activities usually cost between 5,000 and 8,000 yen per month, while music lessons range from 10,000 to 15,000 yen per month. These sports and music classes are often held once a week for 30 minutes to an hour. Tutoring in academic subjects such as mathematics, language, science, and social studies is significantly more expensive—ranging from 30,000 to 70,000 yen per month—due to the longer instruction time, typically

3 Key Facts

3.1 Family Background and Gender Differences in Parental Aspirations for Their Children

We begin by comparing the family characteristics of the two samples, as shown in **Table 1**. Parents in the STEM Sample have higher education levels than those in the Tokyo Sample. The proportion of fathers who are college graduates is similar in both samples (around 62 percent), but 27 percent of fathers in the STEM Sample hold a graduate degree, compared to 15 percent in the Tokyo Sample. Among mothers, 65 percent in the STEM Sample have a college degree and 13 percent hold a graduate degree, whereas in the Tokyo Sample, 52 percent have a college degree and only 4 percent hold a graduate degree.

Regarding family income, the STEM Sample has more high-earning households: 75 percent of families earn over 10 million yen (US$65,000), compared to 39 percent in the Tokyo Sample. Additionally, 23 percent of families in the STEM Sample earn more than 20 million yen (US$130,000), compared to 6 percent in the Tokyo Sample. Children in the STEM Sample participate in extracurricular activities more frequently, averaging 3.7 days per week for boys and 3.8 days per week for girls, compared to 2.1 days per week for boys and 2.3 days per week for girls in the Tokyo Sample.

In the STEM Sample, parental aspirations for graduate education are nearly the same for sons (21 percent) and daughters (22 percent), as are aspirations for a college education (65 percent for sons and 61 percent for daughters).[4] However, parents in the STEM Sample prefer engineering or science majors for their sons (42 percent) more than for their daughters (24 percent), while they prefer medicine or health services for their daughters (7 percent for sons vs. 20 percent for daughters).[5]

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a few sessions per week. On a monthly basis, STEM activities are more costly than sports, comparable to music, but less expensive than academic tutoring.

[4] The wording of the questionnaire concerning the parental aspiration for their children's future degree attainment is: To what level of education do you want your child to advance in the future? (1) until middle school, (2) until high school, (3) until vocational school, (4) until junior college or technical college, (5) until university, (6) until graduate school, and (7) not yet thought about it. We combine (3) and (4) into a single category, referred to as: junior or technical college education.

[5] The wording of the questionnaire for the parental aspiration for the children's field of study in college is: Which field would you prefer your child to pursue: (1) science or engineering (natural sciences,

In the Tokyo Sample, parents are more likely to want their sons than their daughters to obtain a graduate degree (9 percent for sons vs. 5 percent for daughters), while parents choose junior or technical college education for their daughters more than for their sons (2.6 percent for sons vs. 4.2 percent for daughters). In terms of a desirable field of study, these parents prefer engineering or science degrees for their sons (32 percent for sons vs. 15 percent for daughters), while preferring medical or health services (7 percent vs. 12 percent) or humanities or social sciences (10 percent vs. 15 percent) for their daughters. Notably, Tokyo Sample parents are more likely to express no preference for their daughters' field of study (59 percent) compared to their sons (51 percent). Overall, parents in the STEM Sample hold similar educational expectations for their sons and daughters in terms of degree attainment, whereas parents in the Tokyo Sample tend to have higher expectations for sons than for daughters. However, in both samples, parents generally prefer engineering or science degrees for their sons.

3.2 Gender Differences in STEM Activity Participation

We next examine children's participation in extracurricular STEM activities. Girls are less likely than boys to participate in science and robotics classes, with the gender difference more pronounced in robotics. In the STEM Sample, 54 percent of girls and 62 percent of boys have taken science classes, compared to only 1.6 percent and 2.0 percent, respectively, in the Tokyo Sample. For robotics, 17 percent of girls and 34 percent of boys in the STEM Sample have participated, versus 2 percent and 6 percent, respectively, in the Tokyo Sample. The higher participation in the STEM Sample is partly driven by households with one child already enrolled in these classes, whereas science class participation is minimal among families in the Tokyo Sample.[6]

Table 2 shows that in families with multiple children, parents often enroll only one child

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engineering, and agriculture), (2) medical or health services (medicine, dentistry, and pharmacy), (3) humanities or social sciences, and (4) no specific preferences.

[6] There are also gender differences in non-STEM extracurricular activities. Boys are more likely than girls to play soccer (29 percent vs. 3 percent in the STEM Sample; 24 percent vs. 4 percent in the Tokyo Sample), while girls are far more likely to participate in ballet (49 percent vs. 7 percent in the STEM Sample; 25 percent vs. 4 percent in the Tokyo Sample) and music lessons (64 percent vs. 32 percent in the STEM Sample; 35 percent vs. 16 percent in the Tokyo Sample). In contrast, tutoring school participation shows little gender disparity, with nearly equal rates for boys and girls in both samples.

in science or robotics classes. Among families with at least one child enrolled in a science class, only 18 percent (STEM Sample) and 13 percent (Tokyo Sample) have two or more children enrolled. For robotics classes, these figures are 22 percent (STEM Sample) and 18 percent (Tokyo Sample) among families with at least one child enrolled. In contrast, multiple siblings are more likely to participate in non-STEM activities. Among families with at least one child enrolled, 40 percent (STEM Sample) and 57 percent (Tokyo Sample) have two or more children taking tutoring classes, and 53 percent (STEM Sample) and 63 percent (Tokyo Sample) have two or more children in swimming. These findings demonstrate that when parents enroll their children in science or robotics classes, they often choose to enroll only one child, potentially creating disparities in STEM exposure within the same family.

4 Econometric Model and Estimation Results

We estimate a linear probability model to examine the determinants that influence parents' choices or preference ranking for children's extracurricular activities, focusing on science and robotics classes. The model is specified as follows:

$$y_{ij} = \beta_1 Girl_i + \beta_2 X_{ij} + \theta_j + \varepsilon_{ij},$$

where i refers to the child, j refers to the family, and ε_{ij} is an idiosyncratic error term. The variable y_{ij} represents the outcome of interest, $Girl_i$ is a binary variable for whether the child is a girl, X_{ij} is a set of control variables that includes the child's grade, number of children in the family, the parents' education, family income, and the gender of the parent responding to the survey. The model is estimated using (i) ordinary least squares and (ii) a family fixed-effects specification that controls for unobserved family-level heterogeneity θ_j. Including family fixed effects controls for unobserved characteristics that siblings share, such as household environment or family culture, that may influence children's STEM participation. This approach helps address concerns that variation across families may be driven by other factors also affecting participation decisions.[7] Robust standard errors are clustered at the family level

[7] Family fixed effects have the potential to be biased if there are sibling-order-related learning effects; for example, if parents adjust their decisions for younger children based on their experiences with older ones, the estimated fixed effects may capture these dynamic adaptations rather than stable family preferences or characteristics. Additionally, the model cannot account for time-varying family shocks, such as changes in income or household circumstances, which may influence children's participation in

in all regressions.

4.1 Gender and Extracurricular STEM Activity Participation

We first present linear probability model estimates using OLS in Panel A of **Table 3**. In the STEM Sample, in which 62 percent of boys participate in science classes, girls are 7 percentage points less likely to enroll, a statistically significant gender gap. In contrast, in the Tokyo Sample, in which only 2 percent of boys participate in science classes, girls are just 0.2 percentage points less likely to participate, a difference that is statistically insignificant. In both samples, families with multiple children are less likely to enroll any child in science classes, while those with a father holding a graduate degree or with a household income of 20 million yen or over are more likely to do so.

For robotics classes, girls are significantly less likely to participate than boys. In the STEM Sample, while 34 percent of boys participate, girls are 19 percentage points less likely to do so. In the Tokyo Sample, 6.2 percent of boys participate, and girls are 4.0 percentage points less likely to do so. Households with earnings of 20 million yen or more are positively associated with robotics participation in both samples.

Panel B in **Table 3** reports family fixed-effects estimates. In the STEM Sample, girls are 31 percentage points less likely than boys to participate in science classes. Parents who aspire for a particular child to earn a graduate degree are 63 percentage points more likely to enroll that child in science classes, compared to those who want that child to pursue just a college degree. Parents who prefer humanities or social sciences for their children are less likely to enroll them in science classes compared to those who express no specific preference for a field of study for their children. For robotics classes, girls in the STEM Sample are 30 percentage points less likely than boys to participate.

In the Tokyo Sample, girls are 0.6 percentage points less likely to participate in science classes and 2.5 percentage points less likely to participate in robotics classes than boys. These smaller, insignificant estimates for science reflect the very low science participation rates in the Tokyo Sample (just 2.0 percent of boys). Consequently, the next subsection examines parental

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different ways over time.

preference rankings for STEM activities in the Tokyo Sample.

It is notable that in the STEM Sample, the family fixed-effects estimates of the gender gap in science and robotics participation (–0.309 and –0.298, respectively) are larger in magnitude than the corresponding OLS estimates (–0.070 and –0.187). By contrast, in the Tokyo Sample, the fixed-effects estimate for robotics participation (–0.025) is smaller in magnitude than the OLS estimate (–0.040). This divergence can be attributed to sample selection in the STEM Sample, which includes only families in which at least one child participates in a STEM activity, thereby disproportionately including families with participating boys. The fixed-effects estimates in the STEM Sample capture a more pronounced gender gap in STEM participation, because (1) the identification of the family fixed-effect estimation stems from within-sibling, cross-gender contrasts in outcomes and (2) sibling pairs in which the brother participates but the sister does not are much more common than the reverse in the STEM Sample.

4.2 Gender Differences in Parental Preference Rankings for STEM Extracurricular Activities

We use the Tokyo Sample to investigate gender differences in parents' ranking of STEM extracurricular activities for their children, given the low participation rates in such activities within this sample. The results, presented in **Table 4**, are based on the family fixed-effects estimation.[8] The dependent variables are indicators for whether an activity is ranked as a parent's first choice, second (or better), third (or better), fourth (or better), or fifth (or better).

For science classes, there are no significant gender differences in parents' first, second, or third preferences. This is due to the low share of parents who select science as a top extracurricular activity. Among boys, only 0.5 percent of their parents rank science as the first choice, 1.9 percent within the top two, and 4.5 percent within the top three. As the share increases to 8.6 percent for boys when considering the top four, parents are 2.7 percentage

[8] The question was worded as follows: Please rank the following extracurricular activities from first to fifth based on your preferences for your child's participation. Include both activities your child is currently attending and those they are not, ranking them according to your preference. For example, if your child is currently taking Soccer and Abacus classes, but your true preference ranking (from first to last) is Soccer, Music, Abacus, Tennis, and Calligraphy, you would answer: 1st place: Soccer; 2nd place: Music; 3rd place: Abacus; 4th place: Tennis; and 5th place: Calligraphy. Even if you do not wish for your child to participate in any activities, please answer based on what you would choose if you had to.

points less likely to include science among the top four choices for girls compared to boys. Similarly, when considering the top five choices—where 12.4 percent of parents include science for boys— parents are 3.8 percentage points less likely to do so for girls. Thus, a gender gap emerges when considering broader preference rankings beyond the very top.

Parents who aspire for their child to pursue a graduate degree (as opposed to only a college education) are 11 percentage points more likely to include science among their top four extracurricular choices. Likewise, parents who prefer that their child obtain an engineering or science degree in college are 4.5 percentage points more likely to include science among their top three choices and 7.3 percentage points more likely to include it in their top four choices, compared to parents who have no specific preference for their child's field of study. These findings suggest that parents view science classes as a form of human capital investment aligned with aspirations for a future career in engineering or science.

Gender disparities are even more pronounced for robotics. Parents are more likely to rank it either as their top choice or among their top two, three, four, and five choices for boys than for girls—with the gender gap widening as the ranking expands. Parents who prefer an engineering or science major for their child also tend to show a positive inclination toward robotics, ranking it among their top choices.

4.3 Parental Preference Rankings for STEM Activity by Child's Grade Level

Lastly, we examine how parents' rankings of science and robotics classes vary with the child's grade level—kindergarten, lower elementary, upper elementary, and middle school; our findings appear in **Table 5**. This table reports the percentage of parents who include these classes in their top five preferences. For science classes, 7.4 percent of the parents of kindergarten girls and 10 percent of the parents of kindergarten boys list it among their top five choices—a 3 percentage point difference that is not statistically significant. However, as children advance in grade level, parental interest in science classes for their children increases for both girls and boys, and the gender gap becomes significant. The differences are 3.2 percentage points in lower elementary, 4.6 percentage points in upper elementary, and 4.6 percentage points in middle school. By middle school, 13 percent of parents of girls and 18

percent of parents of boys rank science among their top five choices.

For robotics, a clear gender gap emerges even in kindergarten: 17 percent of parents of kindergarten girls versus 29 percent of kindergarten boys include robotics in their top five, a 12 percentage point difference. This gap remains at 12 percentage points in lower elementary school, and expands in upper elementary school (to 14 percentage points) and middle school (to 18 percentage points). By middle school, 27 percent of parents of girls and 45 percent of parents of boys list robotics among their top five extracurricular preferences.

In sum, parents' preferences for extracurricular STEM activities diverge by gender well before high school. The direct effects on their children's actual intentions can be seen in a 2020 survey of tenth graders at public high schools (i.e., Tokyo's designated high schools for academic excellence) (Usui et al., 2024), which found that female students reported a 14 percent likelihood of choosing STEM fields in college, compared to 34 percent for male students. These percentages were almost identical to the figures for their parents: parents of female students predicted a 15 percent likelihood of their daughters choosing a major in a STEM field, compared to 35 percent for parents of male students. This disparity is particularly concerning since most Japanese college-preparatory high schools require students to choose a science or humanities track by the start of eleventh grade, while only a few implement this at the start of twelfth grade (National Institute for Educational Policy Research, 2013). Consequently, these early gender differences may lead girls to opt out of the science track; this in turn would limit their exposure to advanced math and science courses in high school and ultimately narrow their future STEM opportunities in college.[9]

5 Conclusion

We find that girls are less likely than boys to participate in extracurricular STEM activities in the Tokyo area of Japan. Moreover, when parents rank their preferred extracurricular activities for their children, they are more likely to favor science and robotics for sons than for

[9] This contrasts with the United States, where, according to Hyde et al. (2008), girls' lower enrollment in advanced math and science courses was once one of the major explanations for boys outperforming girls on standardized tests in high school. However, by 2000, high school girls were taking calculus as the same rate as boys, resulting in women earning 48 percent of undergraduate degrees in mathematics in the US.

daughters. Parents who lean toward science classes as an extracurricular activity for a particular child also tend to aspire for that child to pursue (i) a graduate degree or (ii) a college major in engineering or science. Notably, these aspirations are more often directed toward boys.

These gender-differentiated parental attitudes and experiences shape children's skills, knowledge, expectations, and motivations related to science. Parents who value science and believe their children excel in it are more likely to involve them in scientific activities—a form of positive reinforcement that fosters interest in science and a self-image aligned with a future career in the field (Eccles-Parsons et al., 1983; Sonnert, 2009; López and Cabello, 2022; Giannola, 2024). As Crowley et al. (2001) emphasize, parental encouragement not only creates opportunities for children to engage with science but also nurtures their interest and values regarding the discipline.[10] It is important to note that, at present, we cannot disentangle the extent to which our results reflect (1) parental decisions based on their own preferences, or (2) parental decisions informed by their perceptions of the child's interests or the child's own intrinsic preferences. Although this distinction remains unclear, our findings indicate that parents provide different opportunities to boys and girls, with boys receiving greater exposure to STEM education from early childhood on. These insights point to the need for early interventions—by both parents and educators—to mitigate gender disparities in STEM engagement well before the high school years, when critical academic track decisions are made, in order to address the persistent underrepresentation of women in STEM careers.

[10] Dabney et al. (2011) further emphasize the importance of STEM extracurricular activities in primary and secondary education for fostering these students' interest in, and eligibility for, university coursework in advanced science and mathematics, with implications for their eventual career paths. They argue that, in addition to middle school interest in science, participation in STEM-related activities beyond the classroom (e.g., clubs and competitions) at the university level is associated with a higher likelihood of indicating a STEM career interest.

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Table 1. Summary statistics of variables of interest

Variables	**STEM Sample**	**Tokyo Sample**	
Family Characteristics			
Father's Education			
Less than High School	0.003	0.013	
High School	0.035	0.111	***
Junior or Technical College	0.066	0.112	*
University	0.623	0.617	
Graduate School	0.272	0.146	***
Mother's Education			
Less than High School	0.000	0.008	
High School	0.029	0.121	***
Junior or Technical College	0.192	0.311	***
University	0.647	0.518	***
Graduate School	0.131	0.042	***
Family Income			
10 million yen and over	0.745	0.387	***
20 million yen and over	0.234	0.056	***
N	388	3114	

	STEM Sample			**Tokyo Sample**		
Variables	**Girls**	**Boys**		**Girls**	**Boys**	
Children's Extracurricular Activities						
Science	0.537	0.616	*	0.016	0.020	
Robotics	0.171	0.341	***	0.020	0.062	***
Swimming	0.615	0.644		0.462	0.517	***
Gymnastics	0.405	0.425		0.221	0.233	
Baseball	0.034	0.116	***	0.014	0.088	***
Soccer	0.029	0.294	***	0.035	0.241	***
Ballet	0.493	0.066	***	0.251	0.044	***
Music	0.629	0.316	***	0.352	0.155	***
Art	0.146	0.094		0.059	0.032	***
Tutoring	0.693	0.691		0.411	0.417	
Activities, Days per Week	3.724	3.844		2.136	2.290	***
Parental Aspiration for Child's Future Education						
Junior High School	0.000	0.009		0.005	0.004	
High School	0.010	0.003		0.035	0.037	
Junior or Technical College	0.005	0.009		0.042	0.026	***
University	0.646	0.611		0.727	0.710	
Graduate School	0.214	0.215		0.045	0.085	***
Not Yet Thought about It	0.126	0.146		0.146	0.137	
Parental Aspiration for Child's Future Field of Study						
Engineering or Science	0.235	0.424	***	0.145	0.317	***
Medical or Health Services	0.201	0.071	***	0.116	0.074	**
Humanities or Social Sciences	0.029	0.016	*	0.146	0.099	***
No Specific Preferences	0.534	0.489		0.593	0.510	***
N	217	342		2,208	2,321	

Note: The STEM Sample is the sample from the parents of children who participate in the science or robotics classes of a private tutoring school. The Tokyo Sample is the sample from the Tokyo metropolitan area.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2. Number of families with one or more children participating in each extracurricular activity (Sample: Families with two or more children)

	STEM Sample			Tokyo Sample		
	No. of Families with ≥1 Participating Child	No. of Families with ≥2 Participating Children	% with ≥2 Participating Children	No. of Families with ≥1 Participating Child	No. of Families with ≥2 Participating Children	% with ≥2 Participating Children
Activity	(1)	(2)	(3)	(4)	(5)	(6)
Science	152	28	18%	56	7	13%
Robotics	78	17	22%	97	17	18%
Turtoring	174	69	40%	1074	610	57%
Swimming	143	76	53%	1145	717	63%
Gymnastics	92	36	39%	572	225	39%
Music	116	41	35%	659	289	44%
Art	29	4	14%	114	26	23%
Ballet	71	10	14%	423	103	24%
Baseball	25	6	24%	183	52	28%

Note: The left column indicates the extracurricular activity of interest. Columns 1 and 4 indicate the number of families with at least one child participating in each activity. Columns 2 and 5 indicate the number of families with two or more children participating in the activity. The percentages in Columns 3 and 6 represent the percentage of families with two or more children participating in the activity, among those with at least one child participating in the activity.

Table 3. Gendered effects on the actual choice of children's extracurricular activities

Panel A: OLS

	STEM Sample		Tokyo Sample	
	Science	**Robotics**	**Science**	**Robotics**
	(1)	(2)	(3)	(4)
Female	-0.070*	-0.187***	-0.002	-0.040***
	(0.042)	(0.041)	(0.004)	(0.006)
Number of Children:				
2 Children	-0.223***	-0.047	-0.010*	-0.038***
	(0.046)	(0.049)	(0.006)	(0.008)
3+ Children	-0.372***	-0.085	-0.024***	-0.045***
	(0.064)	(0.069)	(0.005)	(0.010)
Family Income:				
Less than 6 million yen	0.103	0.029	-0.005	-0.001
	(0.160)	(0.203)	(0.004)	(0.008)
9 to 10 million yen	0.017	-0.050	0.001	0.007
	(0.105)	(0.108)	(0.007)	(0.010)
10 to 15 million yen	0.131*	-0.003	0.002	0.013
	(0.079)	(0.073)	(0.006)	(0.008)
15 to 20 million yen	0.032	0.105	0.020*	0.020
	(0.097)	(0.084)	(0.011)	(0.014)
20 million and over	0.127	0.151*	0.043***	0.071***
	(0.091)	(0.086)	(0.015)	(0.022)
Father's Education:				
High School Dropout			0.013	0.002
			(0.016)	(0.018)
High School	0.118	0.071	-0.002	0.002
	(0.158)	(0.153)	(0.005)	(0.011)
Some College	-0.083	0.137	0.003	-0.001
	(0.073)	(0.102)	(0.005)	(0.010)
Graduate School	0.104*	0.002	0.019**	0.017
	(0.053)	(0.055)	(0.008)	(0.012)
Mother's Education:				
High School Dropout			0.011	-0.041***
			(0.026)	(0.008)
High School	-0.030	-0.044	-0.010**	-0.017
	(0.195)	(0.157)	(0.005)	(0.011)
Some College	-0.119**	0.005	-0.012***	-0.023***
	(0.057)	(0.059)	(0.004)	(0.007)
Graduate School	-0.021	-0.004	-0.002	0.013
	(0.071)	(0.071)	(0.013)	(0.022)
R^2	0.119	0.056	0.016	0.034
N	525	525	4529	4529
Male Mean	0.616	0.341	0.020	0.062

Note: Each column in the table represents ordinary least squares estimates from separate regressions. The dependent variable in each regression is an indicator that corresponds to the extracurricular activity indicated at the top of the column. The reference category for parental education is university, and the reference category for family income is 6 million to 9 million yen. All regressions control for child's grade level (kindergarten, upper elementary school, and middle school) and the gender of the parent who responded to the survey. "Male Mean" is the mean of the dependent variable among boys. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 3. Gendered effects on the actual choice of children's extracurricular activities (*continued*)

Panel B: Fixed Effects

	STEM Sample		Tokyo Sample	
	Science	**Robotics**	**Science**	**Robotics**
	(1)	(2)	(3)	(4)
Female	-0.309***	-0.298***	-0.006	-0.025***
	(0.077)	(0.076)	(0.006)	(0.009)
Grade Level (Reference Category: Lower Elementary School)				
Kindergarten	-0.422***	-0.169*	-0.019**	-0.022**
	(0.105)	(0.089)	(0.010)	(0.011)
Upper Elementary School	0.032	0.073	0.012*	0.028***
	(0.086)	(0.065)	(0.007)	(0.010)
Middle School	0.098	0.113	0.015*	0.028**
	(0.112)	(0.105)	(0.008)	(0.013)
Parental Aspiration for Child's Future Education (Reference Category: University)				
High School			-0.027	-0.005
			(0.029)	(0.028)
Junior or Technical College			-0.003	0.013
			(0.034)	(0.009)
Graduate School	0.632***	0.016	0.037	0.078
	(0.122)	(0.225)	(0.028)	(0.049)
Not Yet Thought about It	-0.023	0.126	0.008	0.047**
	(0.204)	(0.142)	(0.006)	(0.022)
Parental Aspiration for Child's Future Field of Study (Reference Category: Have No Specific Preference)				
Engineering, Science	0.011	0.102	0.007	0.054**
	(0.142)	(0.108)	(0.011)	(0.024)
Medical, Health Services	0.353	-0.063	0.009	0.017
	(0.219)	(0.170)	(0.022)	(0.030)
Social Sciences, Humanities	-0.427*	-0.014	-0.002	-0.022
	(0.227)	(0.236)	(0.019)	(0.025)
R^2	0.313	0.234	0.011	0.043
N	525	525	4529	4529
Male Mean	0.616	0.341	0.020	0.062

Note: Each column in the table represents family fixed-effect estimates from separate regressions. The dependent variable in each regression is an indicator that corresponds to the extracurricular activity indicated at the top of the column. All regressions control for child's grade level. "Male Mean" is the mean of the dependent variable among boys. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4. Gendered effects on parental preference rankings for science and robotics classes: Fixed-effects model

The Tokyo Sample:

	Parental Preference for Science					Parental Preference for Robotics				
	1st	Up to 2nd	Up to 3rd	Up to 4th	Up to 5th	1st	Up to 2nd	Up to 3rd	Up to 4th	Up to 5th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Female	0.001	0.004	0.002	-0.027**	-0.038**	-0.014**	-0.040**	-0.067**	-0.122**	-0.149***
	(0.003)	(0.007)	(0.011)	(0.013)	(0.015)	(0.006)	(0.011)	(0.015)	(0.019)	(0.020)
Parental Aspiration for Child's Future Education (Reference Category: University)										
Middle School	0.001	-0.012	0.034	0.069	0.031	-0.001	0.238	0.255	0.192	0.144
	(0.005)	(0.014)	(0.032)	(0.043)	(0.041)	(0.015)	(0.213)	(0.216)	(0.168)	(0.168)
High School	0.003	-0.003	-0.005	-0.069	-0.071	0.041	0.041	0.049	0.071	-0.032
	(0.003)	(0.048)	(0.061)	(0.061)	(0.066)	(0.032)	(0.056)	(0.067)	(0.082)	(0.090)
Junior or Technical College	0.001	-0.003	0.016	0.084**	0.048	0.010	-0.003	0.007	-0.025	-0.072
	(0.002)	(0.008)	(0.018)	(0.036)	(0.043)	(0.007)	(0.046)	(0.047)	(0.059)	(0.070)
Graduate School	-0.010*	-0.025	0.030	0.113**	0.105**	-0.004	-0.013	-0.001	0.003	-0.017
	(0.005)	(0.023)	(0.053)	(0.054)	(0.052)	(0.037)	(0.050)	(0.073)	(0.071)	(0.070)
Not Yet Thought about It	0.002	-0.001	0.026	0.024	-0.017	0.014	0.005	0.009	0.067	0.041
	(0.002)	(0.007)	(0.026)	(0.035)	(0.044)	(0.020)	(0.032)	(0.045)	(0.051)	(0.058)
Parental Aspiration for Child's Future Field of Study (Reference Category: Have No Specific Preference)										
Engineering, Science	0.016*	0.002	0.045*	0.073**	0.049	0.024	0.052*	0.115***	0.138***	0.132***
	(0.009)	(0.018)	(0.024)	(0.029)	(0.033)	(0.018)	(0.028)	(0.037)	(0.041)	(0.041)
Medical, Health Services	0.002	0.017	0.047	0.089**	0.061	0.023	0.050	0.090*	0.061	0.134***
	(0.004)	(0.020)	(0.029)	(0.035)	(0.041)	(0.018)	(0.038)	(0.046)	(0.049)	(0.049)
Social Sciences, Humanities	-0.016	-0.015	0.028	0.031	0.053	0.007	0.022	0.011	0.013	-0.010
	(0.011)	(0.017)	(0.022)	(0.037)	(0.040)	(0.014)	(0.024)	(0.034)	(0.046)	(0.050)
R^2	0.010	0.002	0.006	0.021	0.014	0.011	0.027	0.041	0.063	0.085
N	4529	4529	4529	4529	4529	4529	4529	4529	4529	4529
Male Mean	0.005	0.019	0.045	0.086	0.124	0.024	0.067	0.135	0.214	0.298

Note: Each column in the table represents family fixed-effect estimates from separate regressions. The dependent variable in each regression is an indicator that corresponds to the parental preference rankings for the particular activity indicated at the top of the column. In the second row, the numbers in boldface indicate parental preferences as follows: "1st" means that subject was the parents' first choice, "Up to 2nd" means that subject was parents' first or second choice; "Up to 3rd" means that subject was parents' first, second, or third choice, and so forth. All regressions control for child's grade level. "Male Mean" is the mean of the dependent variable among boys.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5. Parental preference rankings for science/robotics classes by child's grade level

The Tokyo Sample

	Kindergarden			Lower Elementary			Upper Elementary			Middle School		
Parental Preference	**Girls**	**Boys**		**Girls**	**Boys**		**Girls**	**Boys**		**Girls**	**Boys**	
for Science	(1)	(2)		(3)	(4)		(5)	(6)		(7)	(8)	
1st	0.0%	0.3%		0.3%	0.3%		0.0%	0.9%	**	0.3%	1.4%	**
Up to 2nd	1.1%	1.1%		0.7%	1.9%	*	2.2%	1.9%		1.7%	4.3%	**
Up to 3rd	1.8%	3.3%		2.6%	5.4%	**	4.5%	5.3%		4.2%	7.3%	**
Up to 4th	5.0%	7.9%		6.4%	8.9%		7.4%	11%	**	7.5%	13%	***
Up to 5th	7.4%	10%		9.1%	12%	**	11%	15%	**	13%	18%	**
N	379	366		607	644		649	684		573	627	
Parental Preference for Robotics												
1st	1.3%	1.9%		1.3%	3.6%	**	1.8%	3.1%		1.6%	4.0%	**
Up to 2nd	4.0%	4.4%		3.5%	9.0%	***	5.2%	9.4%	***	4.7%	11%	***
Up to 3rd	7.9%	12%	*	7.6%	16%	***	9.4%	18%	***	10%	23%	***
Up to 4th	12%	19%	***	14%	25%	***	15%	28%	***	18%	35%	***
Up to 5th	17%	29%	***	22%	34%	***	22%	36%	***	27%	45%	***
N	379	366		607	644		649	684		573	627	

Note: In the far-left column, the numbers in boldface indicate parental preferences as follows: "1st" means that subject was the parents' first choice, "Up to 2nd" means that subject was parents' first or second choice; "Up to 3rd" means that subject was parents' first, second, or third choice, and so forth. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$