Gender Stereotypes About Intellectual Ability in Japanese Children

Mako Okanda
Otemon Gakuin University
Xianwei Meng
Osaka University
Yasuhiro Kanakogi
Osaka University
Moe Uragami
Sugiyama Jogakuen University
Hiroki Yamamoto
Osaka University
Yusuke Moriguchi (moriguchi.yusuke.8s@kyoto-u.ac.jp)
Kyoto University

Research Article

Keywords: gender stereotype, gender gap, intellectual ability, stereotype threat

Posted Date: May 11th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-478260/v1

Abstract

Japan has a large gender gap; thus, this study examined whether Japanese 4- to 7-year-old children exhibit a “brilliance = males” stereotype and whether parental attitudes toward gender roles were related to children’s stereotypes. We also explored whether children exhibit such stereotypes in response to various stimuli. We showed children photo (Study 1) and stick-figure (Study 2) stimuli of men, women, boys, and girls, asking them to attribute traits (smart or nice) to each. Unlike previous studies in the U.S., there were sex differences early in boys’ and girls’ attribution of smart or nice; however, a developmental transition was observed in 7-year-olds. In Study 1, 7-year-old girls were more likely to attribute nice, and 6-year-old boys were more likely to attribute smart, to their own sex, respectively. In Study 2, girls generally attributed nice to their own sex compared to boys, while only 7-year-old boys were more likely to attribute smart to their own sex compared to girls. Parental attitudes toward gender roles were unrelated to children’s gender stereotypes. The results indicated that Japanese children may acquire “brilliance = males” stereotypes later than American children (7-years-old). Further, the results were clearer when children were presented with stick figure stimuli.

Introduction

Although many nations have been committed to promoting gender equality in the last several decades, the gender gap remains one of the biggest issues in the 21st century. A typical gender gap has been observed in scientific communities: fewer women work in certain professional areas than men and there are fewer female authors appearing in science, technology, engineering, mathematics, and medicine (STEMM) areas[1]. These areas are traditionally believed to be for men, and people’s beliefs that “men are better at science than women” are examples of a gender stereotype which does not reflect the truth[2].

Developmental psychologists have been interested in the origin of gender stereotypes. Previous studies have reported that people, including school-age children, adolescents, college students, parents, and teachers in elementary schools, are generally likely to believe that math, science, and computers are for boys and men rather than for girls and women[3–7]. For instance, Miller et al.[8] reported that American k-12 children were more likely to draw a man when they were told to draw a scientist. Although fewer children have shown this tendency during the last five decades, children were still more likely to draw a male scientist as they grew older[8]. Such gender stereotypes could not only limit adult women’s but also girls’ careers[9].

Gender stereotypes are not limited to a particular field that requires logical reasoning abilities, such as math, science, and computers. People are also likely to associate more fundamental abilities, such as intellectual ability (e.g., brilliance and genius) to men[9,10]. This tendency was robustly observed in adults living in 78 countries in Europe, Asia, Latin America, the Caribbean countries, and Africa[11]. A previous study reported that the “brilliance = males” stereotype emerged among children as early as six years of age in the U.S. and a similar developmental pattern was observed with the “nice = female” stereotype[9].

Additionally, American 5- to 7-year-old children were less likely to choose a female teammate for a game that was designed for really smart children[10] and 6-year-old girls were less likely to be interested in such a game[9].

Therefore, three issues must be explored in the present study. First, it is important to investigate whether children's "brilliance = males" stereotype is observed in a country with a larger gender gap. In 2020, the World Economic Forum reported that the gender gap (regarding general gender balance of four categories: economic participation and opportunity, educational attainment, health and survival, and political empowerment) in Japan was ranked 120th, while the United States was ranked 53rd out of 156 countries. Previous studies have indicated that the level of the national gender gap could influence gender stereotypes. For example, national implicit gender-science stereotypes such as "math/science for males" predicted 8th -grade children's math/science performance in 34 countries[12]. Similar results were also reported with math and reading abilities in 15-year-olds from 40 countries[13]. Moreover, women's participation rate in science areas has also been related to gender-science stereotypes in a study with 66 countries[14]. As noted above, Holman et al.[1] explored academic authors within STEMM areas' genders from 2002 to 2017 and reported that the percentage of female authors in Japan was the lowest (20.4%). Therefore, Japan is a good sample to explore children's "brilliance = males" stereotypes as a society with a large gender gap. In the present study, we surveyed 4- to 7-year-old Japanese children.

Second, it is important to investigate whether "brilliance = males" stereotypes exhibit as a result of various stimuli. Bian et al.[9] used photo stimuli of males and females that controlled for attractiveness and clothes; however, they did not control for colors. It is well known that some colors, such as pink or blue, are considered gender-stereotyped colors[15–17]. Moreover, one study reported that blue could be associated with competence[18]. Photo stimuli could also include other rich perceptual cues such as faces, hairstyles, body shapes, colors, and so on. Such additional information, rather than the concept of gender, could have influenced children's "brilliance = males" stereotype in Bian et al.'s study[9]. Therefore, it might be presumptuous to conclude that children are likely to associate males with brilliance before testing this with a simpler stimulus. The present study used both photos with rich perceptual cues (Study 1) and simple stimuli such as stick figures with fewer perceptual cues (Study 2).

Third, we examined factors that could be related to individual differences in children's gender stereotypes. Parents and teachers are likely to believe that sons (boys) are better at math and science[7,19] or are brilliant[20] and children could learn such gender stereotypes from their parents. In fact, mothers' gender-math stereotypes related to their daughters' math performances under stereotype threat, or when making the female participants' gender identity salient by drawing a girl in a story that the participants had been told[21]. The present study additionally investigated whether Japanese parental attitudes toward gender roles relate to their children's gender stereotypes.

We propose three hypotheses in the present study. First, Japanese children in this large gender gap society would show gender stereotypes for intellectual ability earlier than children in a smaller gender gap society. Children in the U.S. showed such stereotypes at the age of six when asked to associate intellectual ability (i.e., smart) to one sex[9] or even did so at the age of five when asked to choose a teammate to play a game designed for smart children[10]. Given the larger gender gap in Japan (120th) compared to that in the U.S. (53rd), we predicted that Japanese children would show gender stereotypes slightly earlier than the American children in Bian et al.'s study[9]. More importantly, this study investigated how perceptual cues play a role in children's gender stereotypes. Therefore, as the second hypothesis, we expected that children's gender stereotypes would be weaker in Study 2 than in Study 1, assuming that rich perceptual cues induce children's gender stereotypes. Alternatively, children would similarly show gender stereotypes both in studies 1 and 2 if the concept of gender, but not additional perceptual cues such as colors, induces children's gender stereotypes. Third, we hypothesized that parental beliefs about gender roles are related to their children's gender stereotypes. Specifically, if parents have fewer egalitarian attitudes toward gender roles, their children are more likely to exhibit gender stereotypes.

Study 1

We used a colored photo stimulus in Study 1. For both studies 1 and 2, we preregistered our hypotheses, method, primary analyses, and sample size (https://osf.io/h2p5y).

Method

Participants

We determined the sample size based on Study 2 in a previous study[9]. The study included 48 children (24 girls and 24 boys) in each age group and excluded children who failed the screening questions (see below). We recruited 60 participants (30 girls and 30 boys) in each age group because it was difficult to determine the number of children who would pass the screening questions beforehand. The previous study included 5-, 6-, and 7-year-old children; however, we expected that Japanese children would show gender stereotypes earlier than the American children[9]; so, we recruited 240 4-, 5-, 6-, and 7-year-old children (30 girls and 30 boys in each age group) and their parents randomly from a database (Cross Marketing Inc. Tokyo, Japan). A total of 20 children (One 4-year-old, two 5-year-old, two 6-year-old, and five 7-year-old girls, and three 4-year-old, three 5-year-old, two 6-year-old, and two 7-year-old boys) did not pass the screening questions for either one of the two traits (smart or nice); these children were excluded from the analyses. The final sample characteristics are listed in Table 1. There were no significant differences in the months between the girls and boys (p = .339). The children did not have any known developmental abnormalities. Informed consent was obtained from all parents prior to their child's involvement in the study which was conducted in accordance with the principles of the Declaration of Helsinki and approved by the the Ethics Committee of the Unit for Advanced Studies of the Human Mind, Kyoto University.

Gender stereotype task

We followed the procedures of Study 2 in Bian et al.'s study[9] with some modifications. We conducted our experiment online. A parent asked his/her child questions based on written instructions in an online form. To prevent the parent from using his/her own words to instruct his/her child, we explicitly instructed the parent to read the instructions directly; this minimized the influence of the parent. Each child was given a set of six screening questions designed to test whether they understood the meanings of the key terms "smart" (3 questions) and "nice" (3 questions). We used the term "smart" in the present study because the previous study used it as a child-friendly synonym for brilliance [9]. For each question, the parent described a hypothetical child's behavior orally (e.g., "A child learns things fast") and asked their child whether the relevant trait term could be applied to this child (e.g., "Is this child smart, or not smart?"). We used an a priori exclusion criterion of 2/3 for each trait.

As noted above, photo stimuli of Japanese women/men and girls/boys were used in Study 1. Preliminarily, 40 Japanese adults (20 females and 20 males) rated attractiveness ("How attractive does this person look?") for both adult and child photos and clothing ("How professionally is this person dressed?") for adult photos on a seven-point scale. We then used adult photo stimuli that were matched in terms of attractiveness and type of clothing (i.e., how professionally dressed), and child photos that were matched in attractiveness in the main experiment.

There were two tasks. Task (i) included four stories, each of which described a hypothetical adult (child) whose gender was purposely left unspecified. Two stories were about adults and two about children. The stories were about a "really, really smart" person (child), and a "really, really nice" person (child). After the parent told the child one of the stories, the child was shown four pictures in a line (two women and two men or two girls and two boys) and was asked to guess which one of four adults (children) might be the person (child) in the story.

In Task (ii), the child was shown eight webpages one by one. On each page, there were two individuals in the photos. For the first four trials, the pictures included a woman and a man. For the next four trials, the pictures included a girl and a boy. The parent told the child that one of the two people was "really, really smart" (on 4 out of 8 trials) or "really, really nice" (on the other trials) and asked the child to guess which of the two had the relevant trait. The order of the pictures was pseudorandom.

In both tasks, a child received a score of 1 for the trial when he/she chose an adult (a child) of the same gender as themselves (e.g., if a girl picked a woman); otherwise, they received a score of zero. The scores ranged from 0 to 6 for both smart and nice questions.

Gender Role Questionnaire

The parents were provided with the Japanese version of a questionnaire examining their beliefs about gender roles[22] on a five-point scale. This was a single-factor questionnaire and assessed one's attitude toward gender roles, such as marital relationships (e.g., "A husband should decide on important matters in marriage"). We used total questionnaire scores for the analyses.

Analytic plan

We used both adult and child stimuli, and we did not find any differences in the scores between adult and child stimuli. Thus, we combined participants' responses to adult and child stimuli based on a previous study[9].

Children's stereotype scores (combined across the two tasks) were submitted to a multilevel mixed-effects linear model with trait (smart vs. nice; level-1 predictor), gender (boys vs. girls; level-2 predictor), age (4–5-, 6- vs. 7-year-olds; level-2 predictor), and all possible interaction terms set as categorical fixed effects and a random intercept for participants. In addition to these terms, we included parents' sex (mother vs. father) as a categorical fixed effect to control for this effect. We used model simplification by backward elimination of non-significant terms while keeping the parent's sex in the models. Restricted maximum likelihood (REML) was used for the model fitting. The type II sum of squares was used, and degrees of freedom were determined using the Kenward-Roger approximation[23]. When the final model included an interaction term, we conducted follow-up pairwise comparisons, and p values were adjusted using Holm's method[24].

The second analysis assessed the correlations between children's stereotype scores and parents' beliefs about sex roles for each gender.

All analyses were conducted in R 4.0.3 (R Core Team. 2020). We used *the lme4*[25] and *lmerTest*[26] packages for model fitting and backward elimination. We used *the emmeans* package[27] for post-hoc comparisons.

Results And Discussion

Figure 1 shows the developmental changes in children's response scores in Study 1 (see also Supplementary Table S1). To assess whether and how age, sex, and trait were related to the mean gender stereotype scores, we conducted a multilevel mixed-effects linear modeling and backward elimination of non-significant terms. We found no significant effect of interaction among trait, sex, and age, $F(3, 212) = 1.394$, $p = .246$, and interaction between age and sex, $F(3, 211) = 1.214$, $p = .305$. The final model (see also Supplementary Table S2) included significant interaction between trait and sex, $F(1, 215) = 8.513$, $p = .004$, and trait and age, $F(3, 215) = 2.699$, $p = .047$. The main effect of sex was also significant, $F(1, 214) = 189.366$, $p < .0001$.

Since the final model showed that the effects of sex depended on trait, follow-up pairwise comparisons were performed to compare the mean gender stereotype scores between the boys and girls within each question. Girls scored higher than boys in both smart, $t(415) = 8.722$, $p < .0001$, and nice, $t(415) = 12.450$, $p < .0001$, questions.

Since the final model shows that the effect of trait depended on children's sex and age, follow-up pairwise comparisons were performed to compare the mean gender stereotype scores between smart and nice questions within each sex and age. We found that the girls showed no differences in the scores between smart and nice questions at 4, 5, and 6-years-old (*p*s > .05); however, 7-year-olds showed higher scores on the nice questions than the smart questions, $t(215) = 2.770$, $p = .043$. The boys showed no differences between the smart and nice questions at 4, 5, and 7 years of age (*p*s > .05); however, 6-year-olds showed higher scores in the smart questions than the nice questions, $t(215) = 3.133$, $p = .016$.

Next, correlational analyses revealed no correlation between parental attitudes in gender roles and boys' mean gender stereotype scores in the smart ($r = -0.161$, $p = .078$) and the nice ($r = -0.031$, $p = .731$) questions. No relationships were found between the parental attitudes and the girls' mean gender stereotype scores in both the smart ($r = 0.047$, $p = .613$) and nice ($r = 0.023$, $p = .798$) questions.

Overall, Japanese girls' scores were higher than boys for both smart and nice questions. Japanese 7-year-old girls were more likely to attribute nice than smart to their own sex, while younger groups did not. Japanese 6-year-old boys were more likely to attribute smart than nice to their own sex, while other age groups did not. We did not find a relationship between parental attitudes toward gender roles and their children's tendency to attribute smart or nice to their own sex.

In Study 1, we did not completely replicate the findings of Bian et al.'s study[9]. We used a photo stimulus that included rich perceptual cues in Study 1. In Study 2, we used a simpler stimulus that could eliminate the effects of additional information without eliminating the concept of gender.

Study 2

We conducted Study 2 to explore whether "brilliance = males" stereotypes could be observed with simpler stimuli such as stick figures in black and white.

Participants

The same participants in Study 1 participated in Study 2.

Procedure

The procedure was the same as in Study 1, except for three points. First, we used stick figures in black and white instead of the colored photo stimulus. Second, the children were given two questions about whether they understood the gender of stick figures (e.g., "which figures are a woman?") before the main experiment. Finally, the children were given four trials instead of eight trials in Task (ii) to reduce task demand. For the first two trials, the stimuli included a woman and a man. For the next two trials, the stimuli included a girl and a boy. The parent told the child that one of the two people was "really, really smart" (2 out of 4 trials) or "really, really nice" (other trials), and asked the child to guess which of the two had the relevant trait. The scores ranged from 0 to 4 for both smart and nice questions.

Analytic plan

The analyses were the same as in Study 1.

Results and Discussion

Figure 2 shows the developmental change in children's mean gender stereotype scores in Study 2 (see also Supplementary Table S1). We found no significant effect of interaction among trait, sex, and age, $F(3, 212) = 0.875$, $p = .455$, or interaction between age and trait, $F(3, 215) = 0.118$, $p = .950$. The final model (see also Supplementary Table S3) included a significant interaction between trait and sex, $F(1, 218) = 72.680$, $p < .0001$, and a significant interaction between sex and age, $F(3, 211) = 3.511$, $p = .016$. The main effect of sex was also significant, $F(1, 211) = 18.949$, $p < .0001$.

Since the final model showed that the effects of trait depended on children's sex, follow-up pairwise comparisons were performed to compare mean gender stereotype scores between the smart and nice questions within each sex. The girls scored higher on the nice questions than the smart questions, $t(218) = 4.729$, $p < .0001$, whereas the boys scored higher on the smart questions than the nice questions, $t(218) = 7.352$, $p < .0001$.

Since the final model showed that the effects of sex depended on trait and children's age, follow-up pairwise comparisons were performed to compare mean gender stereotype scores between the boys and girls within each question and age. We found that the girls scored higher on the nice questions than boys in each age group (*p*s < .05). Importantly, in the smart questions, the boys showed higher scores than the girls at 7 years of age, $t(274) = 3.097$, $p = .010$); however, this tendency was not observed at 4, 5, and 6 years of age (*p*s > .05).

Correlational analyses revealed no correlation between parental attitudes toward gender roles and boys' scores in the smart ($r = -0.0057$, $p = .531$) and the nice questions ($r = -0.114$, $p = .215$) or the girls' scores in the smart ($r = -0.043$, $p = .636$) and the nice questions ($r = 0.098$, $p = .280$).

In Study 2, we found that Japanese girls were more likely to attribute nice than smart to their own sex, while 7-year-old boys were more likely to attribute smart to their own sex. Again, we did not find a relationship between parental attitudes toward gender roles and their children's tendency to attribute smart or nice to their own sex.

General Discussion

In the present study, we investigated whether gender stereotypes regarding intellectual ability such as "brilliance (smart) = males" would be observed in 4- to 7-year-old Japanese children living in a society with a large gender gap. We tested children's gender stereotypes about intellectual ability (with the child-appropriate word, "smart") using photo stimuli with rich perceptual cues (e.g., faces, hairstyles, body shapes, and colors) which were also used in Study 1in Bian et al.'s study [9] and black and white stick figure stimuli with poor perceptual cues in Study 2. We also examined whether parental attitudes toward gender roles related to children's "brilliance = males" stereotypes.

Partly in line with the previous study[9] and the first hypothesis, the present results revealed that Japanese older children, around about seven years of age, may have gender stereotypes such as "brilliance = males." However, our results differed from those of a previous study[9]. Bian et al.[9] reported sex differences in scores for both smart and nice questions in the older group (6- and 7-year-olds), but not in the youngest group (5-year-olds). In the present study, this pattern was observed only for smart questions in Study 2 and we found sex differences in the younger ages. Japanese girls' scores were higher than boys' for both smart and nice questions in Study 1 and for the nice questions in Study 2. That is, children's tendencies to attribute smart and nice to one sex in the younger ages were different in the two countries. Additionally, children's tendencies were also slightly different in Study 1 with the photo stimuli compared to Study 2 with the stick figure stimuli in the present study. In Study 1, we found a different pattern of "brilliance = males" gender stereotype than was reported by Bian et al.[9], where older boys (6-year-olds) were more likely to attribute smart than nice to their own sex.

Although there was a slight difference between the previous and present studies, we found a developmental transition in the present results. In Study 1, 7-year-old girls were more likely to attribute nice than smart to their own sex, while younger children were not. Six-year-old boys were more likely to attribute smart than nice to their own sex, while 4-, 5-, and 7-year-olds were not. In Study 2, sex differences were observed differently depending on age groups and traits: 4- to 7-year-old girls were more likely to attribute nice to their own sex than boys, and only 7-year-old boys were more likely to attribute smart to their own sex than girls. Moreover, boys' scores for smart questions were higher than for nice questions, while girls' scores for nice questions were higher than for smart questions. That is, the emergence of gender stereotypes in Japan occurs slightly later, around seven years of age, whereas it occurred at six years of age in the U.S.[9].

Contrary to our hypothesis, Japanese children in a large gender gap society showed "brilliance = males" stereotypes later than American children in a small gender gap society. That is, the gender gap in adult contexts might not play a significant role in young children's gender stereotypes regarding intellectual ability. We assumed that educational differences between Japan and the U.S. could be one of the possible factors explaining why Japanese children's emergence of gender stereotypes occurred at a later stage. In the U.S., children generally start kindergartens that are connected to public schools at the age of five, and their curriculum is more like elementary schools', whereas such compulsory education begins in the first grade (at 6–7 years of age) in elementary schools in Japan[28]. Thus, children may acquire gender stereotypes about intellectual ability after they go to schools that teach subjects, including math and science, for compulsory education. Indeed, the effect of schooling was observed in American girls by Bian et al.[9]. Moreover, Japanese preschool teachers may not teach gender equality explicitly but treat all children equally; so, preschool children might be less likely to form gender stereotypes. In fact, Japanese culture does not strictly control young people depending on gender; for example, young boys and girls, particularly around 9–10 years, are allowed to join hot springs for both men and women with their parents. The gender gap might be one factor influencing people's "brilliance = male" stereotypes, but it might be more important for adults than children; there might be other factors leading to young children exhibiting gender stereotypes. Future studies need to explore detailed differences in gender education, how society treats gender differences, or children's media exposure (e.g., how familiar are children with stories that show them boys are smart) in the two countries to clarify why there was a cross-cultural difference between Japanese and American children.

Notably, the results of Study 2 were clearer than those of Study 1. We assume that rich perceptual cues in the photo stimuli made the results ambiguous. Even though the present study and Bian et al.'s[9] controlled for attractiveness and clothing in photo stimuli, other perceptual cues could skew the results. Our results revealed that stick figure stimuli with fewer perceptual cues might be more suitable for cross-cultural testing of gender stereotypes regarding intellectual ability.

We did not find strong evidence that parental attitudes toward gender roles played a role in children's gender stereotypes on intellectual ability. At least around the ages of four to seven years, children might be less likely to acquire gender stereotypes according to their parents' attitudes toward gender roles. Japanese parents may not talk about gender roles with their young children; they may treat boys and girls equally because it is too early to expect that their preschool children will have gender-stereotyped abilities, especially intellectual ones. It might be premature to conclude that parental attitudes do not relate to children's gender stereotypes; therefore, further studies are needed to explore how parental attitudes toward gender roles affect their children at later stages.

The present study has some limitations. First, we conducted it online because of the coronavirus pandemic. Parents instructed, showed stimuli, and questioned their children instead of trained experimenters; therefore, we cannot completely exclude the possibility that the children considered their parents' reactions when they gave responses. Second, the same children were participated in Study 1 and Study 2. It is possible that the children were remembering the photos when they were looking at the stick figures.

The present study has an important implication. A recent report revealed that there is an obvious gender gap in academic sciences[1]. The present study found that the gender gap in adult contexts might not be important for young children to acquire gender stereotypes toward intellectual ability because they might acquire the gender stereotype "brilliance = males" after they go to school. Therefore, if early childhood education at schools is carefully conducted, children might be able to learn gender equality.

Declarations

Acknowledgements

We thank the parents and children who participated in this study. We are also grateful to Dr. Makoto Mizusaki, Megumi Kuwabara, and Sawa Senzaki for their helpful comments.

References

1. Holman, L., Stuart-Fox, D. & Hauser, C. E. The gender gap in science: How long until women are equally represented? *PLoS Biol.* **16**(4), e2004956 (2018). 10.1371/journal.pbio.2004956, Pubmed:29672508
2. Halpern, D. F. *et al.* The science of sex differences in science and mathematics. *Psychol. Sci. Publ. Int.* **8**(1), 1-51 (2007). 10.1111/j.1529-1006.2007.00032.x, Pubmed:25530726
3. Cvencek, D., Meltzoff, A. N. & Greenwald, A. G. Math–gender stereotypes in elementary school children. *Child Dev.* **82**(3), 766–779 (2011). 10.1111/j.1467-8624.2010.01529.x, Pubmed:21410915
4. Cvencek, D., Meltzoff, A. N. & Kapur, M. Cognitive consistency and math–gender stereotypes in Singaporean children. *J. Exp. Child Psychol.* **117**, 73–91 (2014). 10.1016/j.jecp.2013.07.018, Pubmed:24141205
5. Shashaani, L. Gender differences in computer attitudes and use among college students. *J. Educ. Comput. Res.* **16**(1), 37–51 (1997). 10.2190/Y8U7-AMMA-WQUT-R512
6. Tenenbaum, H. R. & Leaper, C. Parent-child conversations about science: The socialization of gender inequities? *Dev.l Psychol.* **39**(1), 34–47 (2003). 10.1037//0012-1649.39.1.34, Pubmed:12518807
7. Tiedemann, J. Gender-related beliefs of teachers in elementary school mathematics. *Educ. Stud. Math.* **41**(2), 191–207 (2000). 10.1023/A:1003953801526
8. Miller, D. I., Nolla, K. M., Eagly, A. H. & Uttal, D. H. The development of children's gender–science stereotypes: A meta–analysis of 5 Decades of U.S. draw–a–scientist studies. *Child Dev.* **89**(6), 1943–1955 (2018). 10.1111/cdev.13039, Pubmed:29557555
9. Bian, L., Leslie, S.-J. & Cimpian, A. Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science* **355**(6323), 389–391 (2017). 10.1126/science.aah6524, Pubmed:28126816
10. Bian, L., Leslie, S.-J. & Cimpian, A. Evidence of bias against girls and women in contexts that emphasize intellectual ability. *Am. Psychol.* **73**(9), 1139–1153 (2018). 10.1037/amp0000427, Pubmed:30525794
11. Storage, D., Charlesworth, T. E. S., Banaji, M. R. & Cimpian, A. Adults and children implicitly associate brilliance with men more than women. *J. Exp. Soc. Psychol.* **90**, 104020 (2020). 10.1016/j.jesp.2020.104020
12. Nosek, B. A. *et al.* National differences in gender–science stereotypes predict national sex differences in science and math achievement. *Proc. Natl Acad. Sci. U. S. A.* **106**(26), 10593–10597 (2009). 10.1073/pnas.0809921106, Pubmed:19549876
13. Guiso, L., Monte, F., Sapienza, P. & Zingales, L. Culture, gender, and math. *Science* **320**(5880), 1164–1165 (2008). 10.1126/science.1154094, Pubmed:18511674

14. Miller, D. I., Eagly, A. H. & Linn, M. C. Women's representation in science predicts national gender–science stereotypes: Evidence from 66 nations. *J. Educ. Psychol.* **107**(3), 631–644 (2015). 10.1037/edu0000005

15. Jonauskaite, D. *et al.* Pink for girls, red for boys, and blue for both genders: Colour preferences in children and adults. *Sex Roles* **80**(9-10), 630–642 (2019). 10.1007/s11199-018-0955-z

16. LoBue, V. & DeLoache, J. S. Pretty in pink: The early development of gender-stereotyped colour preferences. *Br. J. Dev. Psychol.* **29**(3), 656–667 (2011). 10.1111/j.2044-835X.2011.02027.x, Pubmed:21848751

17. Weisgram, E. S., Fulcher, M. & Dinella, L. M. Pink gives girls permission: Exploring the roles of explicit gender labels and gender-typed colors on preschool children's toy preferences. *J. Appl. Dev. Psychol* **35**(5), 401–409 (2014). 10.1016/j.appdev.2014.06.004

18. Labrecque, L. I. & Milne, G. R. Exciting red and competent blue: the importance of color in marketing. *J. Acad. Mark. Sci.* **40**(5), 711–727 (2012). 10.1007/s11747-010-0245-y

19. Yee, D. K. & Eccles, J. S. Parent perceptions and attributions for children's math achievement. *Sex Roles* **19**(5-6), 317–333 (1988). 10.1007/BF00289840

20. Furnham, A., Reeves, E. & Budhani, S. Parents think their sons are brighter than their daughters: Sex differences in parental self-estimations and estimations of their children' multiple intelligences. *J. Genet. Psychol* **163**(1), 24–39 (2002). 10.1080/00221320209597966, Pubmed:11952262

21. Tomasetto, C., Alparone, F. R. & Cadinu, M. Girls' math performance under stereotype threat: The moderating role of mothers' gender stereotypes. *Dev. Psychol.* **47**(4), 943–949 (2011). 10.1037/a0024047, Pubmed:21744956

22. Sakaguchi, Y. & Hashimoto, N. Effects of parents' attitudes toward gender roles on child-rearing and children's social behaviors. *The journal of Kagawa Nutrition University* **40**, 69-77 (2009)

23. Kenward, M. G. & Roger, J. H. Small sample inference for fixed effects from restricted maximum likelihood. *Biometrics* **53**(3), 983–997 (1997). 10.2307/2533558, Pubmed:9333350

24. Holm, S. A simple sequentially rejective multiple test procedure. *Scand. J. Stat* **6**(2), 65–70 (1979)

25. Bates, D., Mächler, M., Bolker, B. & Walker, S. Fitting linear mixed-effects models using lme4. *J. Stat. Soft.* **67**(1), 48 (2015). 10.18637/jss.v067.i01

26. Kuznetsova, A., Brockhoff, P. B. & Christensen, R. H. B. lmerTest Package: Tests in linear mixed effects models. *J. Stat. Soft.* **82**(13), 26 (2017). 10.18637/jss.v082.i13

27. Lenth, R. V., 2021. emmeans: Estimated marginal means, aka least-squares Means. R package version 1.5.4, . Avairable from: https://CRAN.R-project.org/package=emmeans

28. Landerholm, E. Early childhood education in Japan and the United States: A comparison of regular education (Kindergarten and Daycare Programs) and Special Education Programs. *Early Child Dev. Care* **124**(1), 33–47 (1996). 10.1080/0300443961240104

Table

Table 1

Final sample characteristics

Age	Girl		Boy	
	N	Mean age (SD)	N	Mean age (SD)
4	29	54.66(3.73)	27	54.67 (3.36)
5	28	66.89(3.01)	27	65.56(3.37)
6	28	77.18(3.32)	28	76.5(3.13)
7	25	89.28(3.30)	28	90.00(3.71)

Figures

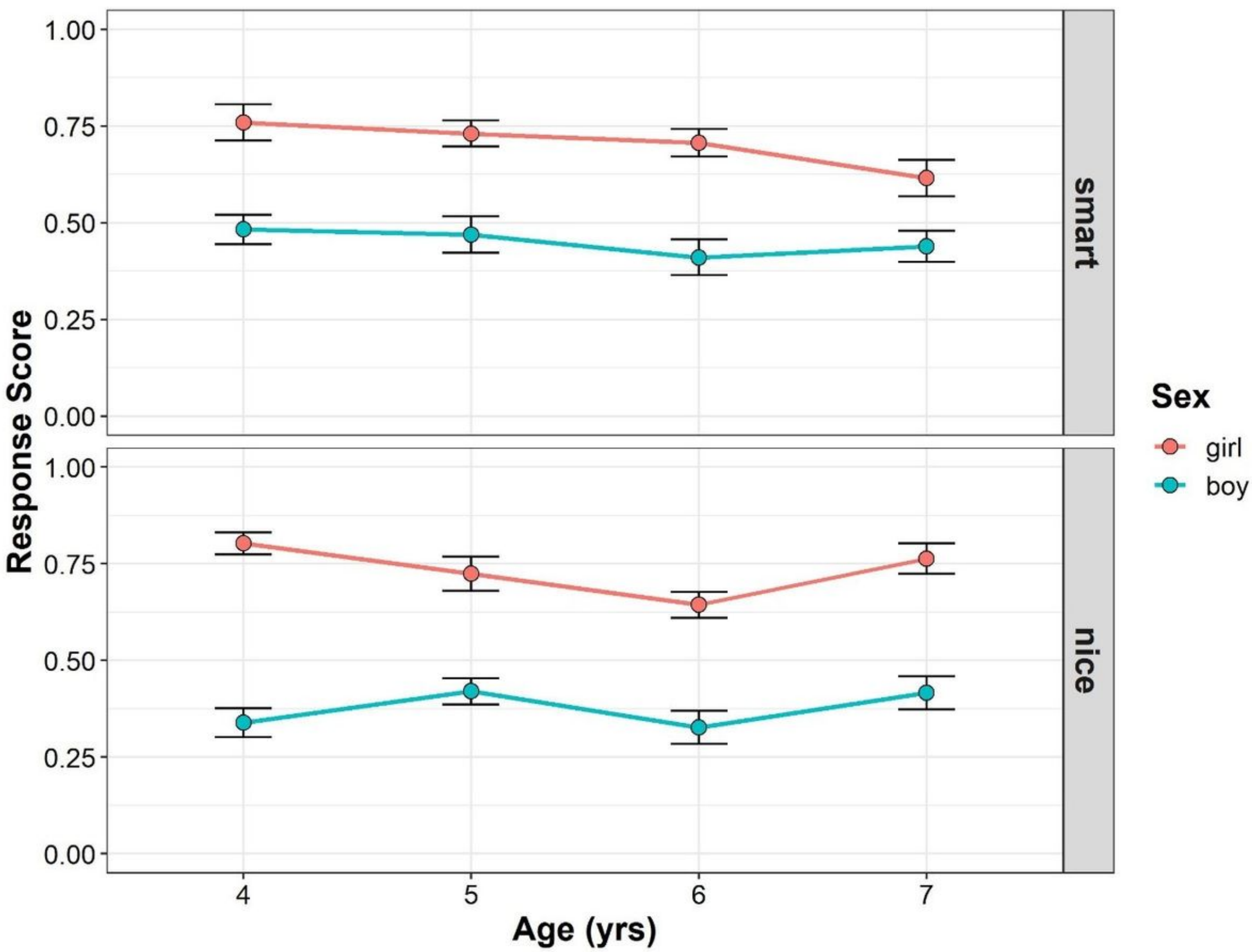

Figure 1

Developmental change of children's response scores in Study 1. Boys' (blue) and girls' (red) mean scores (dots) are shown. Error bars represent ± 1 SE.

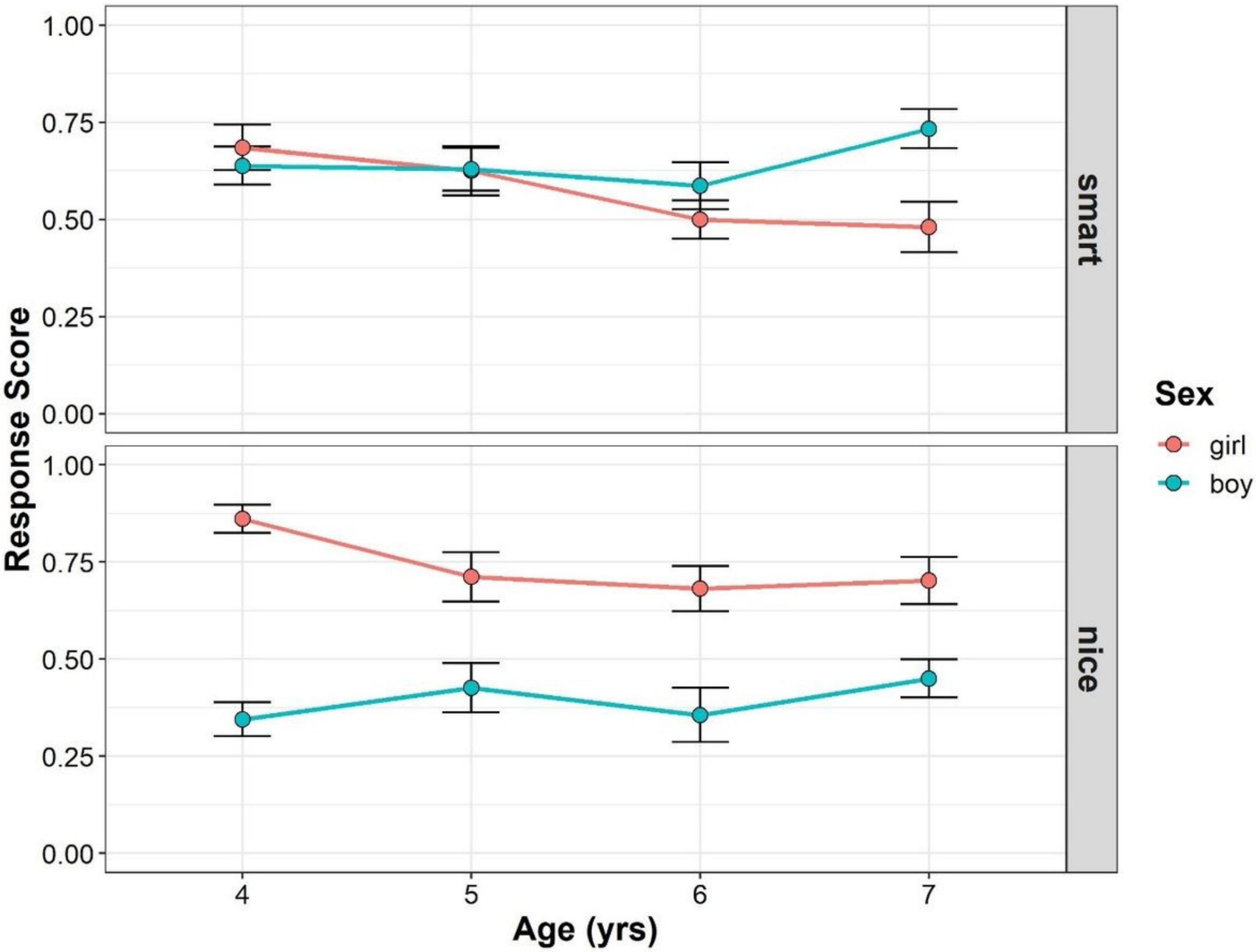

Figure 2

Developmental change of children's response scores in Study 2. Boys' (blue) and girls' (red) mean scores (dots) are shown. Error bars represent ± 1 SE.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryInfoFile.pdf