

Why are there so few Women in STEM in Japan?

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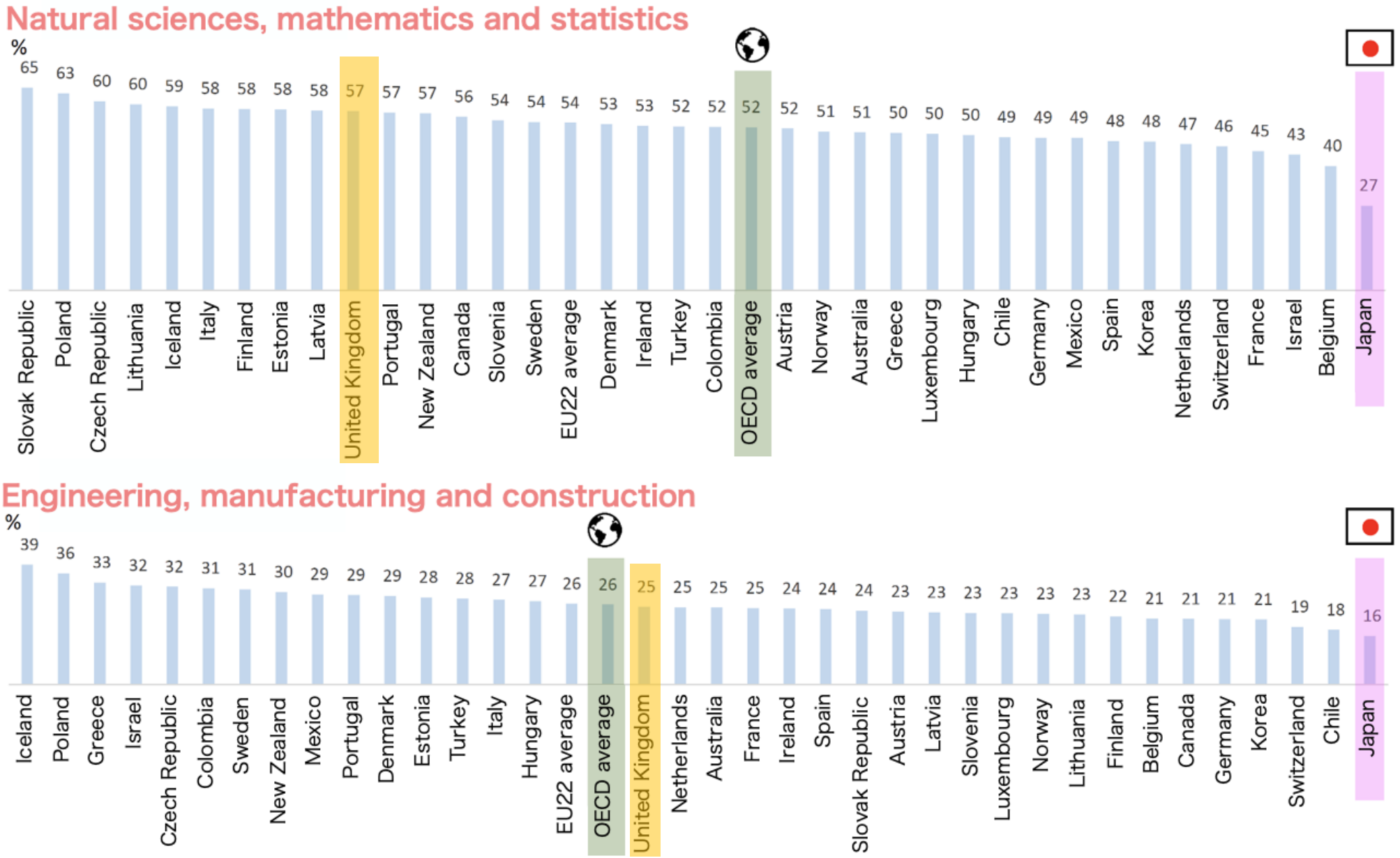
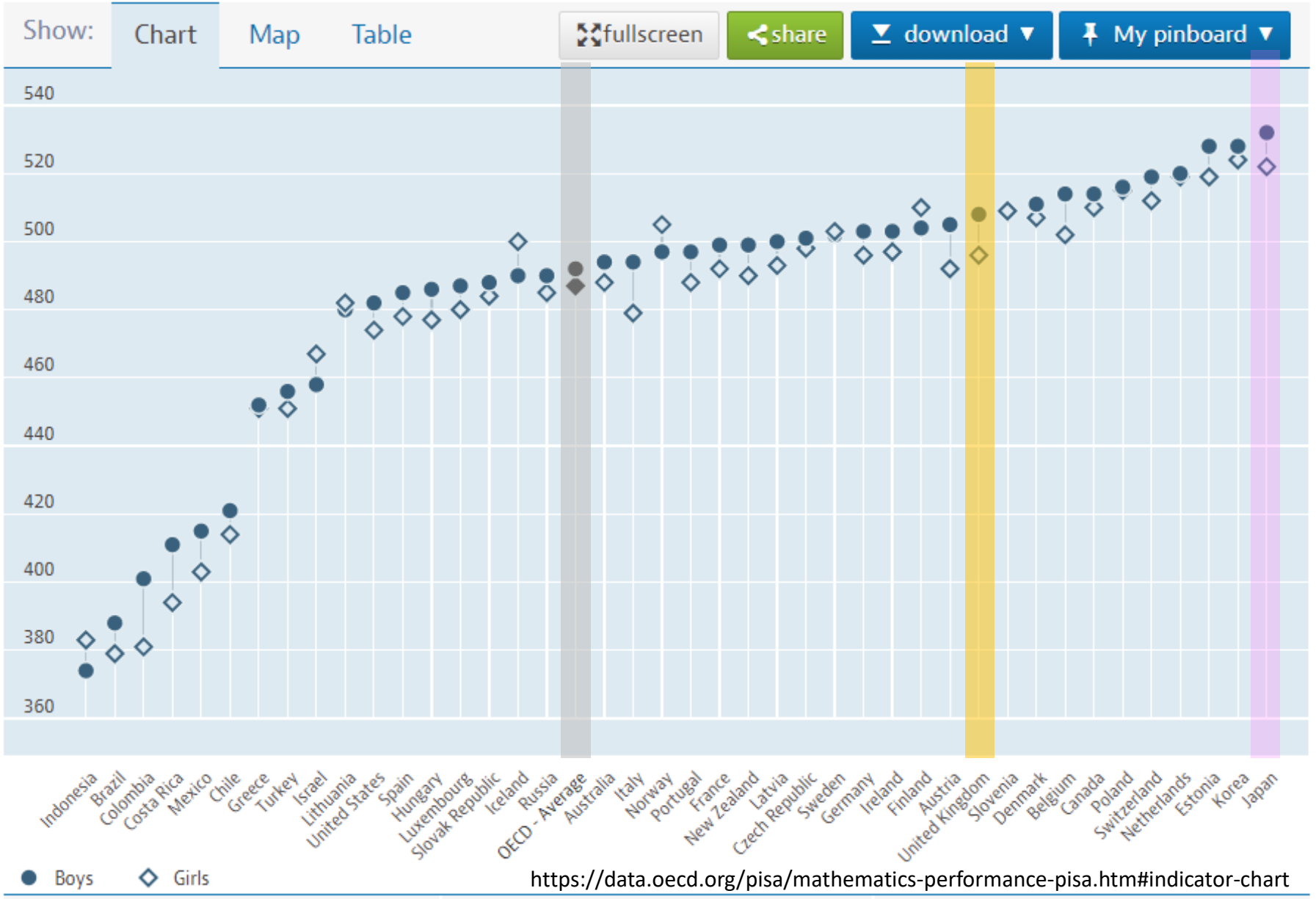
RIETI Policy Symposium on July 3, 2025

Female students ratio, OECD countries

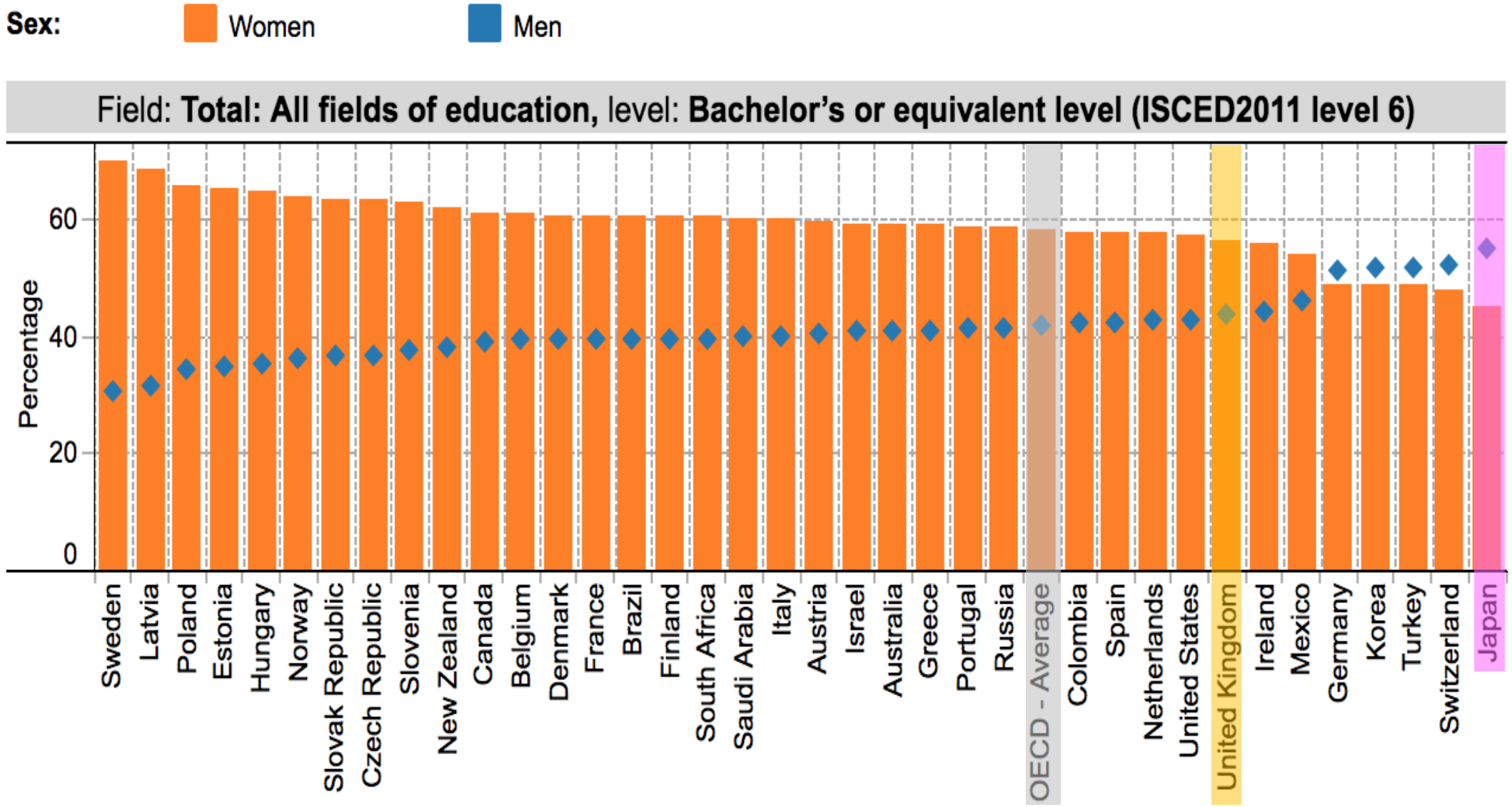


PISA, 15 years old, Mathematics scores



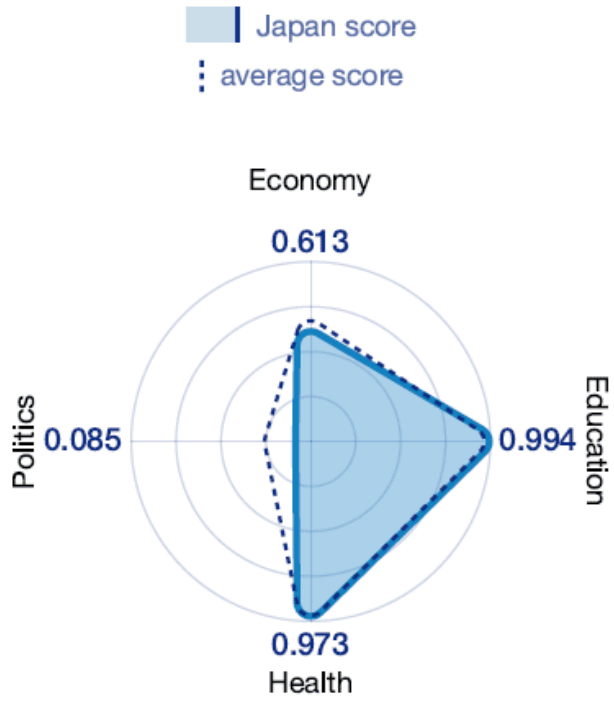
https://data.oecd.org/pisa/mathematics-performance-pisa.htm#indicator-chart

All fields, Bachelor's female ratio



Economy Profile	Score (imparity = 0, parity = 1)	Rank (out of 148 countries)	Index Edition
Japan	**0.666**	**118th**	**2025**

Global Gender Gap Index 2025 Edition



Overview

Index and Subindex	2025 Score	2025 Rank	▼ 2024 Score	▼ 2024 Rank
Global Gender Gap Index	0.666	118th	0.663	118th
Economic Participation and Opportunity	0.613	112th	0.568	120th
Educational Attainment	0.994	66th	0.993	72nd
Health and Survival	0.973	50th	0.973	58th
Political Empowerment	0.085	125th	0.118	113th

Global Gender Gap Index Indicators 2025

Indicator	Rank	Score*	Compare with Global average	Difference F-M	◆ Female vs ◆ Male	Min Max

Expectancy-value theory
(Eccles & Wigfield, 2020; Wigfield & Eccles, 2000)

Social cognitive career theory
(Lent et al., 1994)

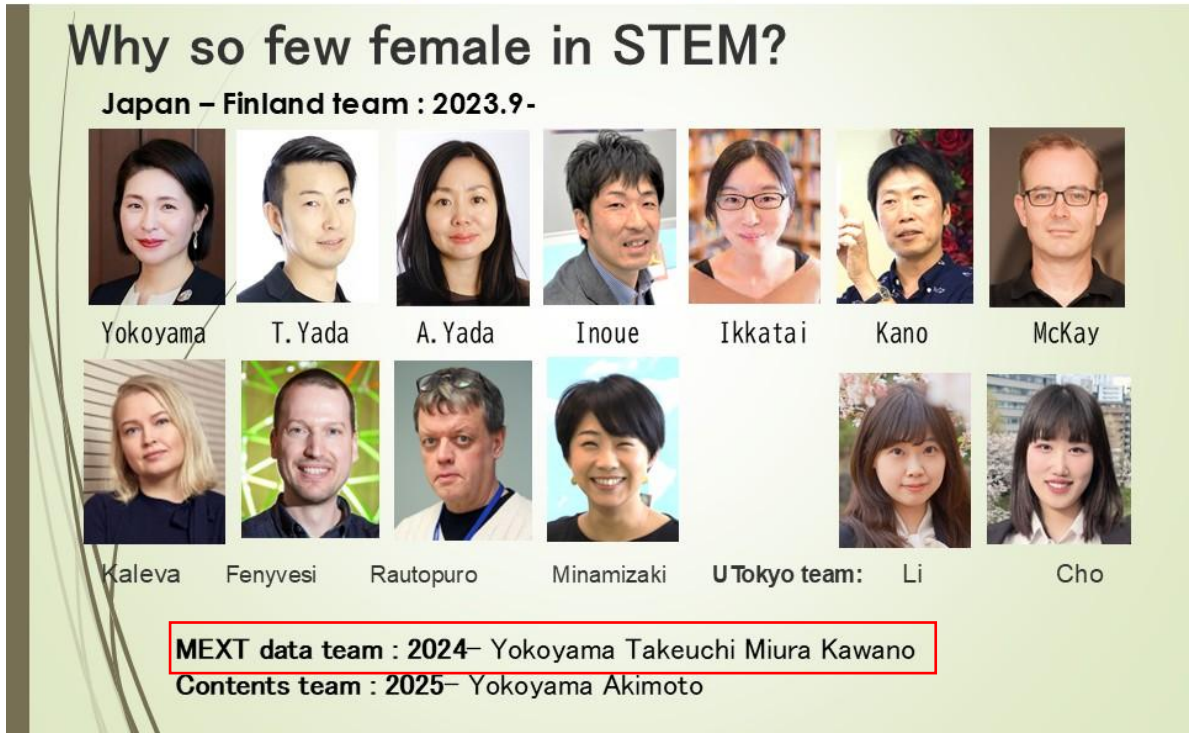
There were no Climate research
Research on the public perception of Climate

1st project 2017-2021

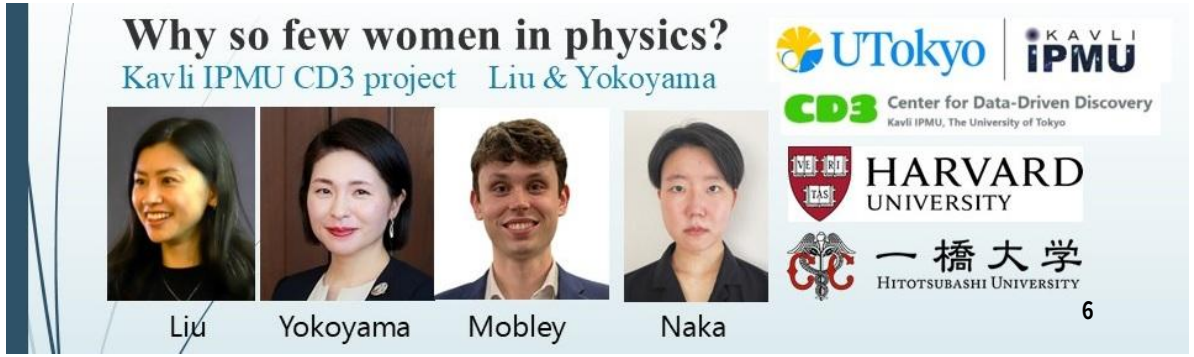
KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE
RISTEX 社会技術研究開発センター Research Institute of Science and Technology for Society
UTokyo FSI

2nd project 2023-

UTokyo | KAVLI IPMU
金沢大学 KANAZAWA UNIVERSITY
滋賀大学
名古屋大学 NAGOYA UNIVERSITY
JYVÄSKYLÄN YLIOPISTO UNIVERSITY OF JYVÄSKYLÄ
KYUSHU UNIVERSITY
上智大学 SOPHIA UNIVERSITY



3rd project 2024-

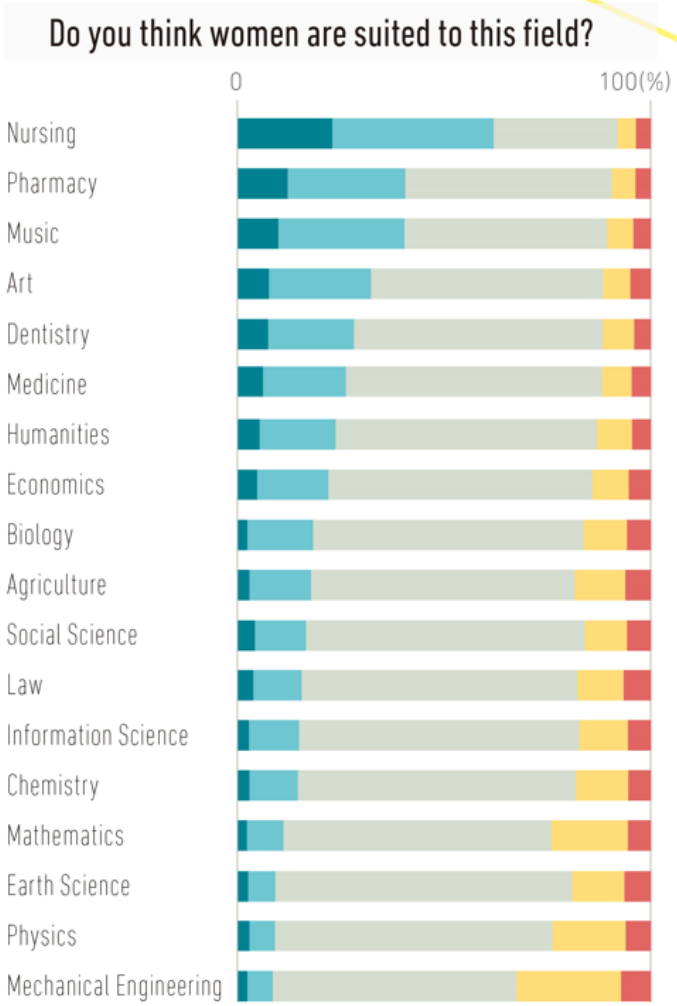


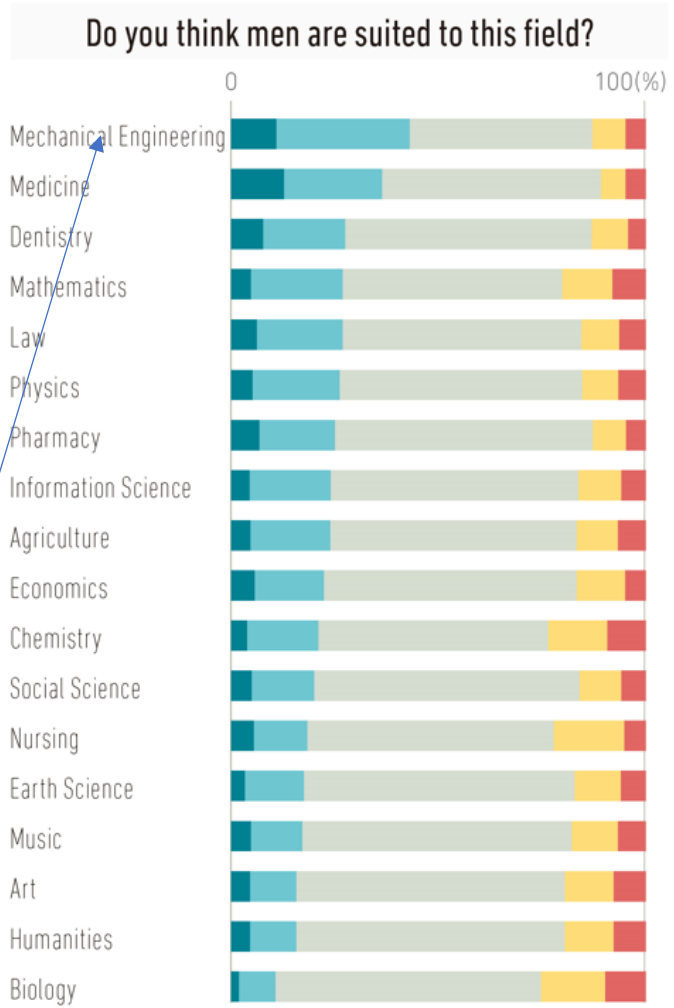
1. Public perception（一般イメージ）

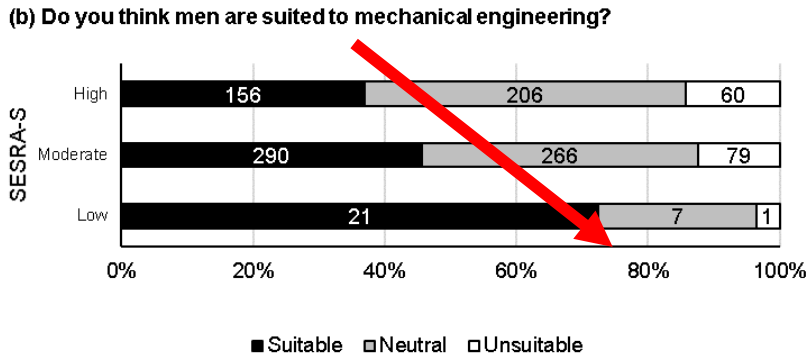
Ikkatai, Y., Minamizaki, A., Kano, K., Inoue, A., McKay, E., & Yokoyama, H. M. (2020). Gender-biased public perception of STEM fields, focusing on the influence of egalitarian attitudes toward gender roles. Journal of Science Communication, 19(1), A08.

online survey 2019 in Japan
1086 men and women aged 20-69
541 men, 545 women
Randomized by gender, age and region

Widely-held preconceptions that nursing is for women and mechanical engineering for men

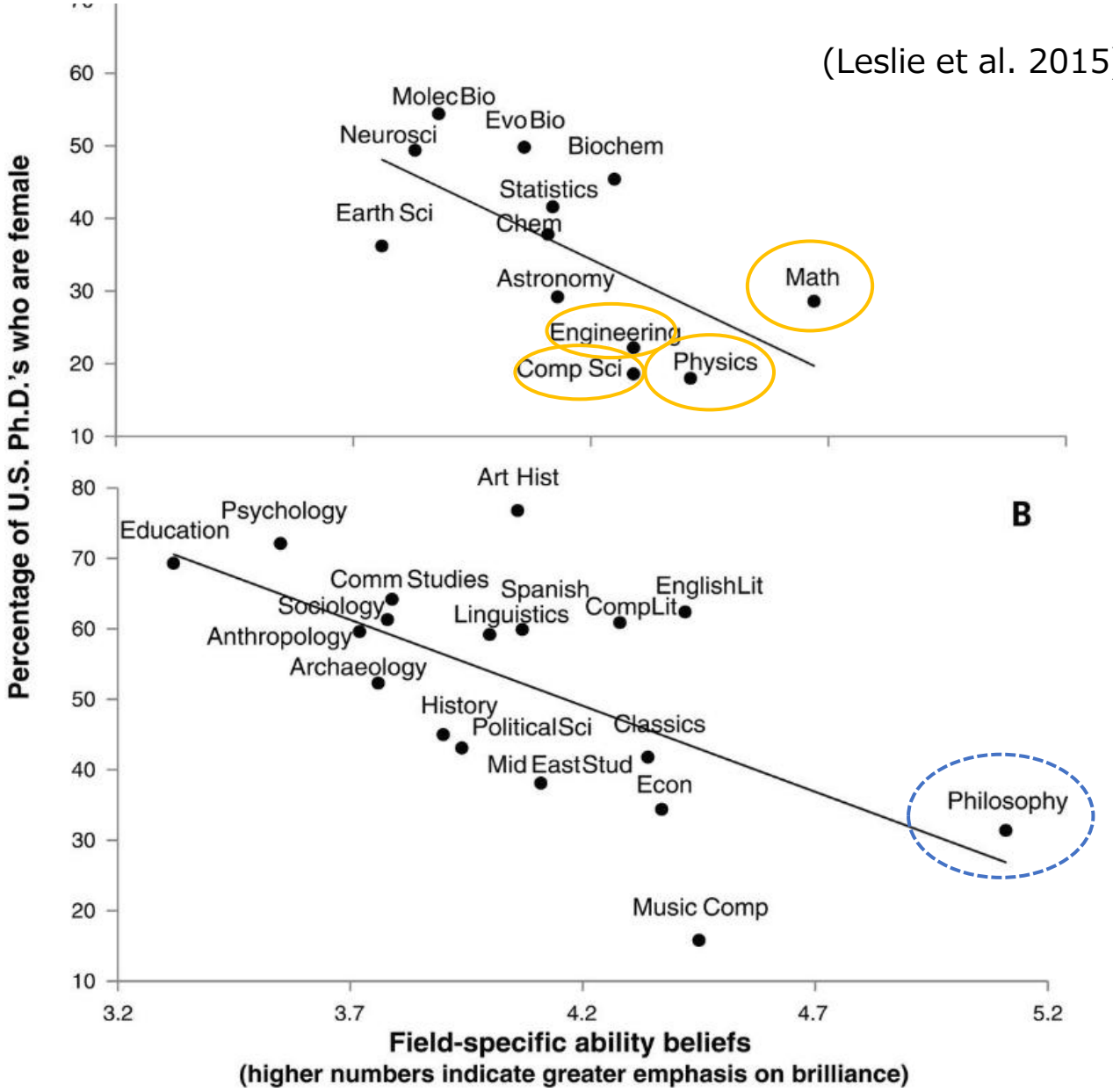






Field – specific ability beliefs (Brilliance)

(Leslie et al. 2015)

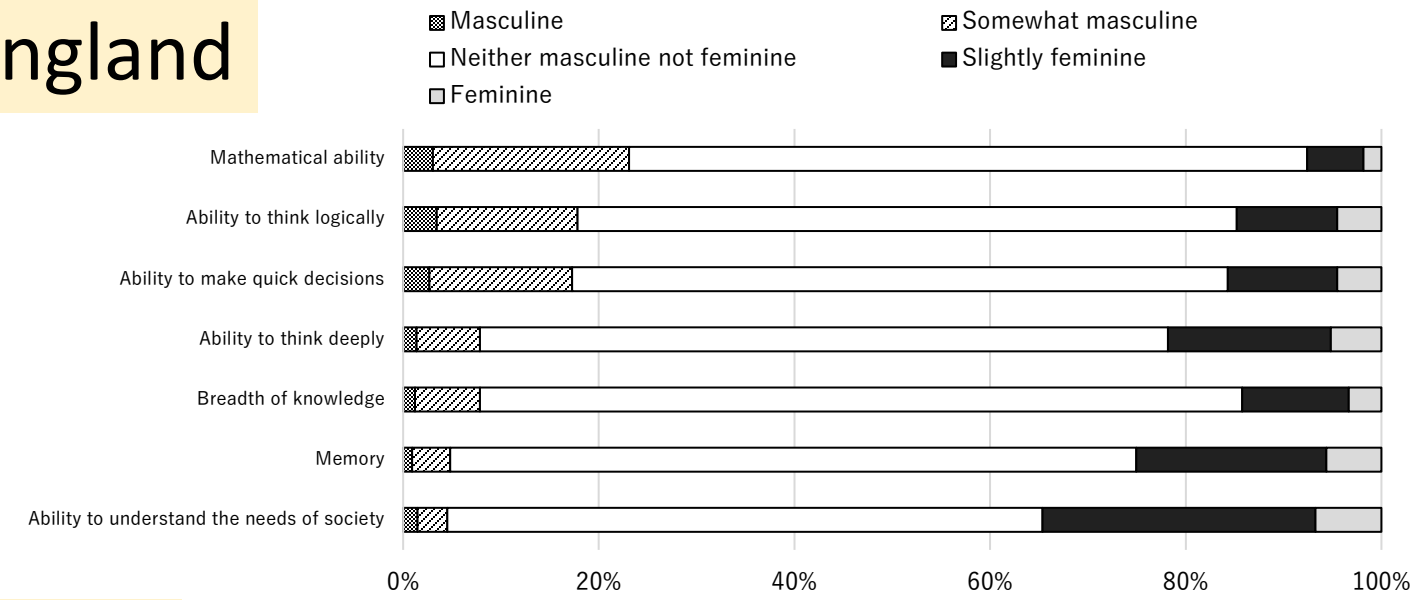


2. Ability stereotype（能力ステレオタイプ）

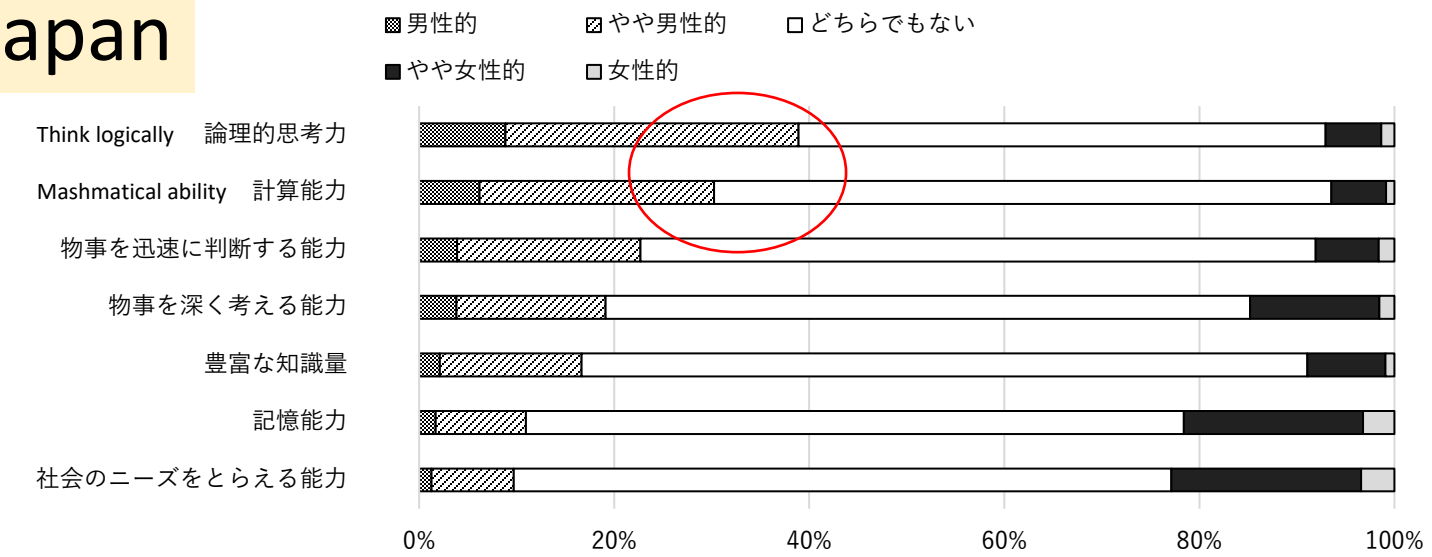
一方井祐子・井上敦・南崎梓・加納圭・マッカイユアン・横山広美（2021）．STEM分野に必要とされる能力のジェンダーイメージ：日本とイギリスの比較研究．科学技術社会論研究.
(Ikkatai, Yuko, Atsushi Inoue, Azusa Minamizaki, Kei Kano, Euan McKay, Hiromi Yokoyama (2021). gender images of abilities needed in STEM fields: a comparative study of Japan and the United Kingdom. Journal of Science, Technology and Society.)

Online Survey 2019
1177 men and women aged 20-69
583 males and 594 females
Allocated by gender, age, and region

England



Japan



3. Girl's perception（女子生徒の視点）

井上敦・一方井祐子・南崎梓・加納圭・マッカイユアン・横山広美（2021）．高校生のジェンダーステレオタイプと理系への進路希望, 科学技術社会論研究.(19) 64-78
(Inoue, Atsushi, Yuko Ikkatai, Azusa Minamisaki, Kei Kano, Euan McKay, and Hiromi Yokoyama (2021). Gender stereotypes and career aspirations for science among high school students, Journal of Science, Technology and Society. (19) 64-78

4. Parents perception(親の視点)

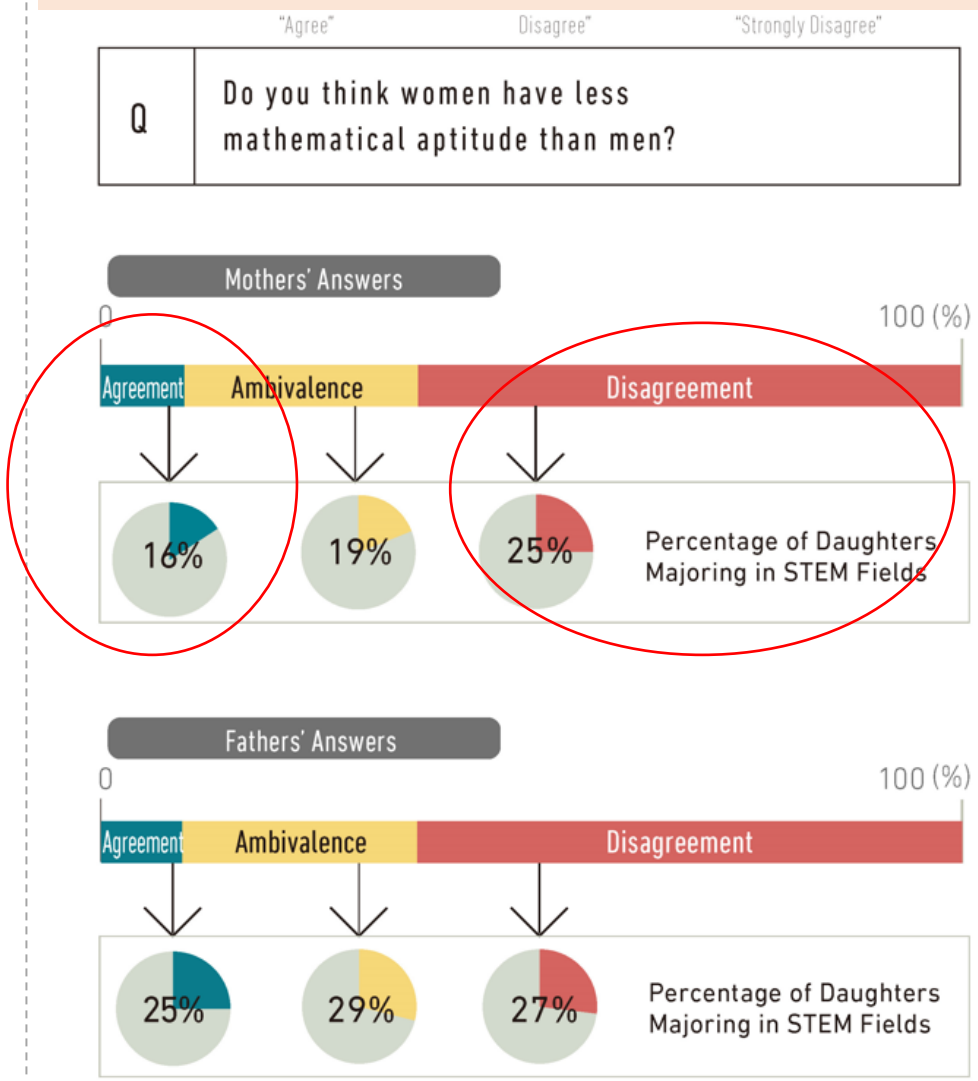
Ikkatai, Y., Inoue, A., Kano, K., Minamizaki, A., McKay, E., & Yokoyama, H. M. (2019). Parental egalitarian attitudes towards gender roles affect agreement on girls taking STEM fields at university in Japan. International Journal of Science Education, 41(16), 2254-2270.

Online Survey 2018
Parents with college-educated daughters
1236 ages 20-69
618 males and 618 females

Finding

- Parents with inequality attitude disagree with girl's choice to study no only STEM filed but also any field.

井上敦（2019）.親の数学のジェンダーステレオタイプと娘の自然科学専攻.日本科学教育学会第43回年会論文集,9-12.
(Inoue, Atsushi (2019). Parents' Gender Stereotypes of Mathematics and Daughters' Natural Science Majors. Proceedings of the 43rd Annual Meeting of the Japanese Society for Science Education, 9-12.)



5. Social climate effect（社会風土効果）

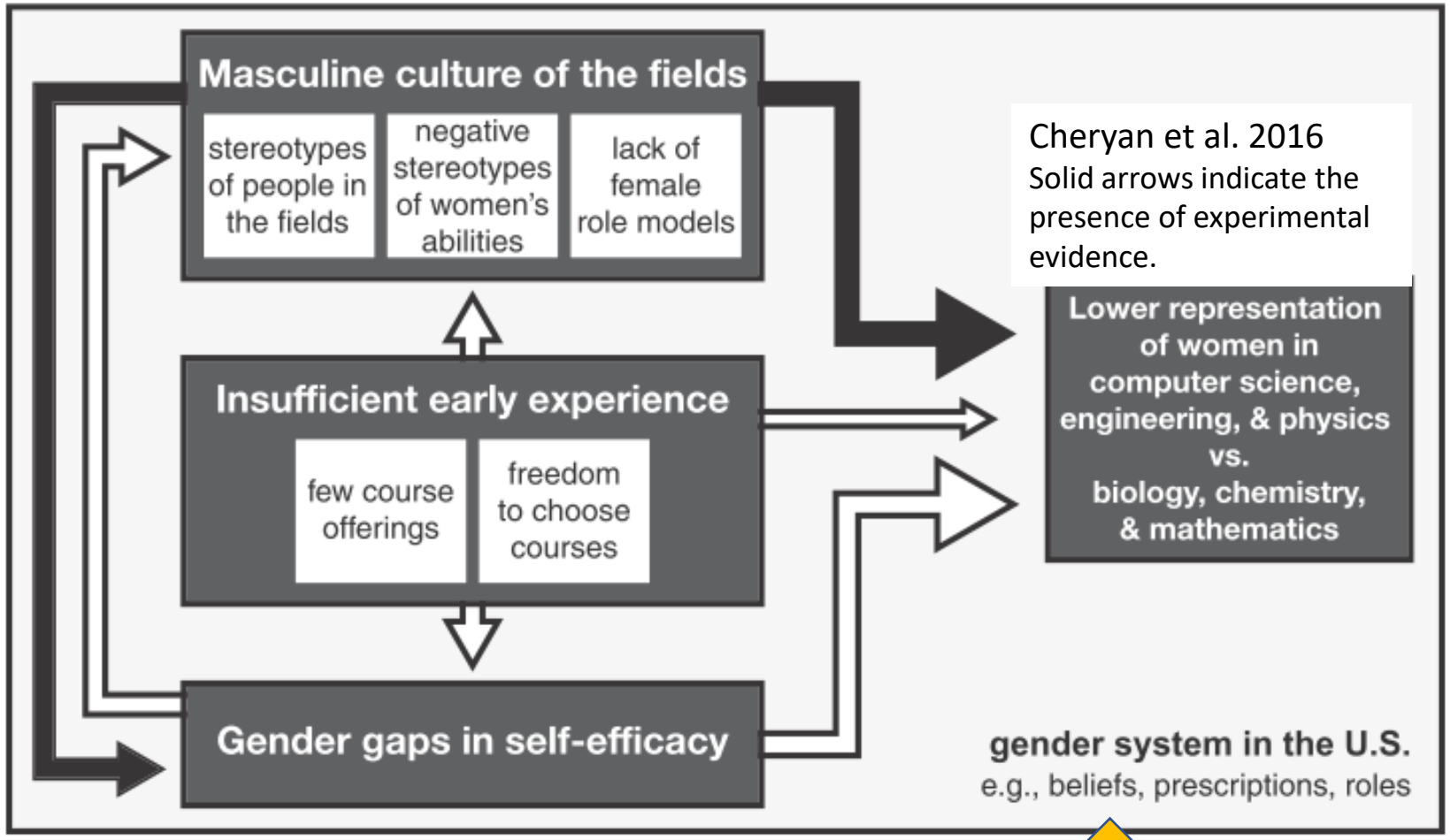
Ikkatai, Y., Inoue, A., Minamizaki, A., Kano, K., McKay, E., & Yokoyama, H. M. (2021). New model of the public image of masculinity in physics and mathematics tested in Japan and England. *Public understanding of science*

①

②

③

④ New!

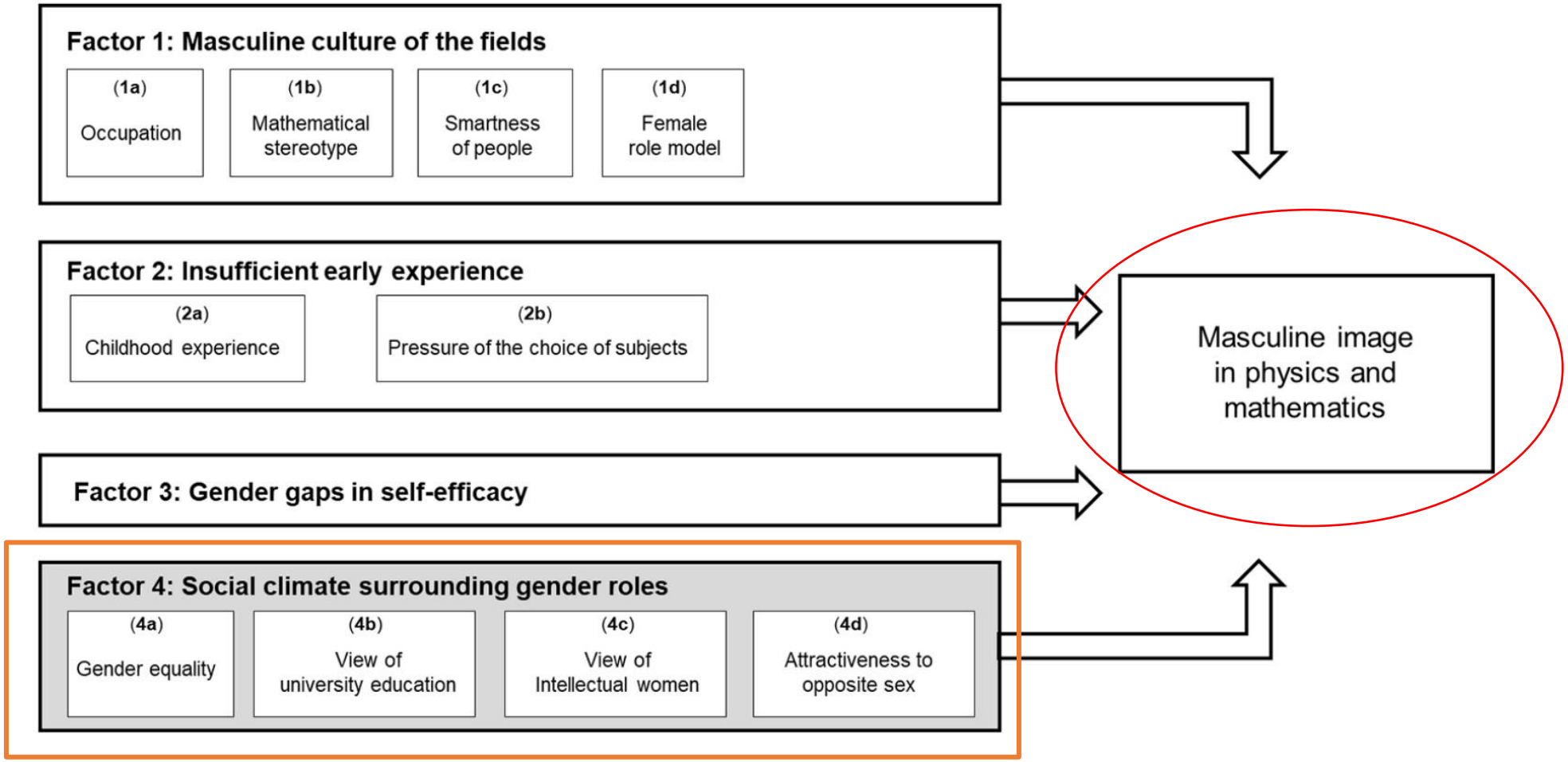


Cheryan et al. 2016
Solid arrows indicate the presence of experimental evidence.

+Social Climate
Gender equalities items

New!

Online Survey, Males and Females aged 20-69
Japan: 1177 subjects Females 593, Males 594
Not UK but England: 1082 Females 553, Males 529



Japan

Factor①

Factor ②

Factor ③

Factor ④

Table 2. Factors affecting public perception of masculinity in physics and mathematics in Japan. Results from ordinal regression analysis.

	Physics						Mathematics					
	Model 1			Model 2			Model 1			Model 2		
	B	SE	*p*	*B*	SE	*p*	*B*	SE	*p*	*B*	SE	*p*
Demography												
Age	–0.01	0.01	.374	–0.01	0.01	.396	0.00	0.01	.407	0.00	0.01	.545
Gender (=men)	–0.13	0.15	.405	–0.10	0.16	.517	–0.48	0.14	.001***	–0.47	0.15	.002**
Education (=undergraduate)	0.28	0.59	.633	0.30	0.59	.615	0.25	0.55	.650	0.27	0.55	.624
Education (=master)	–0.05	0.69	.946	–0.02	0.69	.975	0.67	0.64	.293	0.71	0.64	.267
Factor 1: Masculine culture												
(1a) Occupation	3.31	0.14	.000***	3.30	0.14	.000***	2.80	0.12	.000***	2.81	0.12	.000***
(1b) Mathematical stereotype	0.26	0.08	.001**	0.30	0.09	.001**	0.25	0.07	.001***	0.33	0.09	.000**
(1c) Smartness of people (=other)	–0.91	0.17	.000***	–0.89	0.17	.000***	–0.45	0.16	.004**	–0.44	0.16	.006**
(1d) Female role model (=other)	–0.16	0.27	.565	–0.13	0.27	.622	0.17	0.27	.534	0.18	0.27	.497
Factor 2: Insufficient early experience												
(2a) Childhood experience (=other)	0.43	0.24	.074	0.44	0.24	.066	–0.13	0.19	.501	–0.13	0.19	.472
(2b) Choice of subjects (=other)	–0.19	0.25	.454	–0.19	0.25	.447	–0.33	0.23	.149	–0.36	0.23	.119
Factor 3: Self-efficacy												
Self-efficacy (=other)	–0.25	0.23	.283	–0.25	0.23	.290	0.00	0.16	.999	–0.02	0.16	.912
Factor 4: Social climate for gender roles												
(4a) Gender equality				0.01	0.01	.185				0.02	0.01	.092
(4b) View of university education				0.04	0.10	.665				0.00	0.09	.997
(4c) View of intellectual women				–0.01	0.09	.883				–0.17	0.08	.044*
(4d) Attractiveness to opposite sex (=disagree)				–0.54	0.32	.092				–0.16	0.31	.605
Observations	1177			1177			1177			1177		
Nagelkerke R^2	0.68			0.68			0.59			0.60		

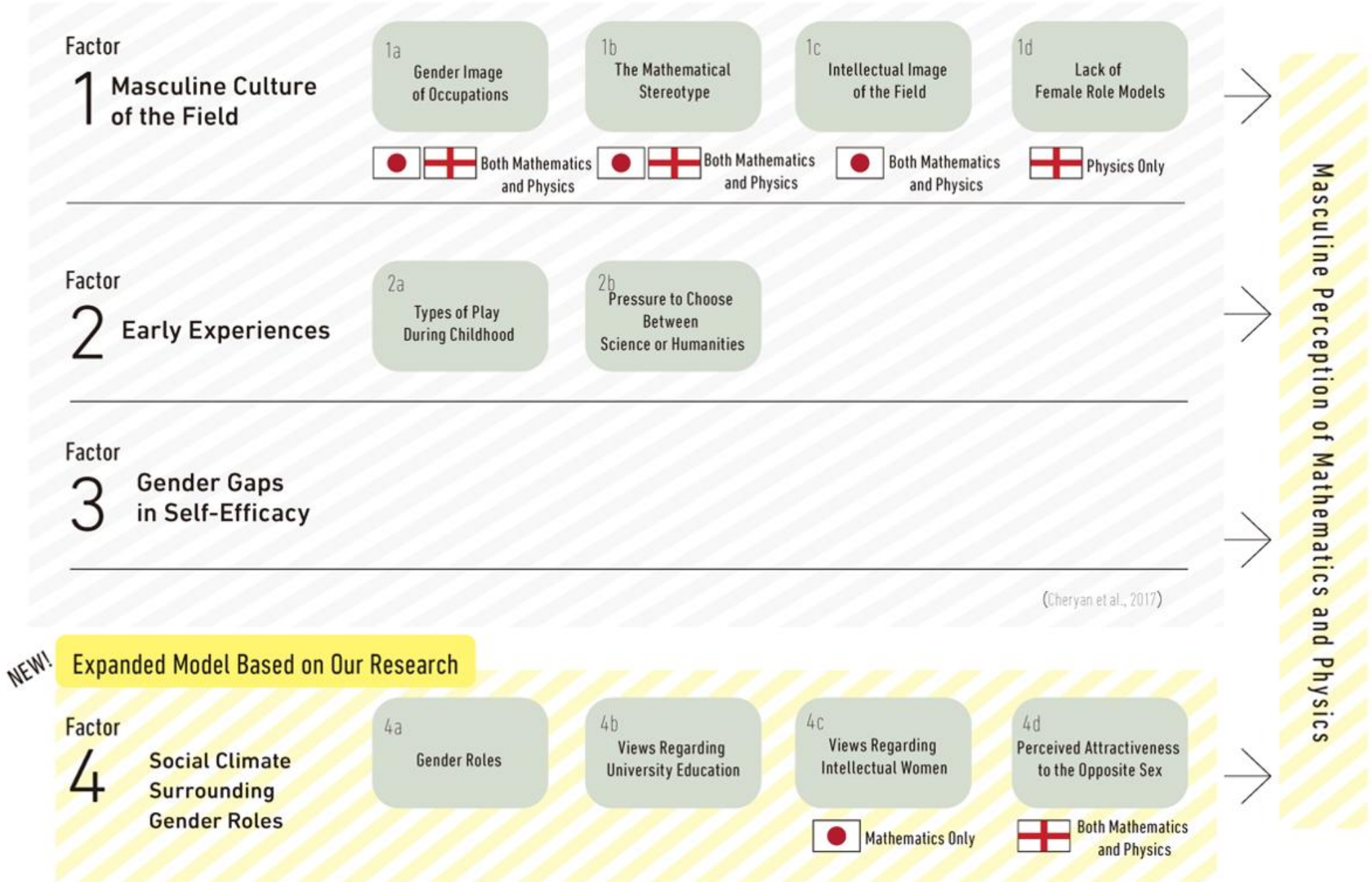
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. SEM shows standard error.

England

Table 3. Factors affecting public perception of masculinity in physics and mathematics in England. Results from ordinal regression analysis.

	Physics						Mathematics					
	Model 1			Model 2			Model 1			Model 2		
	B	SE	*p*	*B*	SE	*p*	*B*	SE	*p*	*B*	SE	*p*
Demography												
Age	0.00	0.01	.571	−0.01	0.01	.219	0.00	0.01	.944	0.00	0.01	.640
Gender (=men)	−0.04	0.16	.778	−0.05	0.16	.761	0.11	0.16	.509	0.12	0.16	.473
Education (=undergraduate)	−0.16	0.39	.687	−0.21	0.39	.587	−0.09	0.43	.841	−0.15	0.43	.727
Education (=master)	−0.08	0.41	.842	−0.09	0.41	.819	−0.09	0.44	.845	−0.10	0.44	.816
Factor ① Factor 1: Masculine culture												
(1a) Occupation	2.24	0.12	.000***	2.26	0.12	.000***	2.25	0.12	.000***	2.25	0.12	.000***
(1b) Mathematical stereotype	0.11	0.07	.094	0.21	0.09	.017*	0.28	0.07	.000***	0.36	0.09	.000***
(1c) Smartness of people (=other)	−0.25	0.20	.205	−0.18	0.20	.384	−0.24	0.21	.262	−0.13	0.21	.532
(1d) Female role model (=other)	0.44	0.17	.011*	0.43	0.17	.013*	0.24	0.17	.146	0.28	0.17	.103
Factor ② Factor 2: Insufficient early experience												
(2a) Childhood experience (=other)	0.29	0.21	.170	0.23	0.22	.298	−0.13	0.18	.468	−0.20	0.18	.276
(2b) Choice of subjects (=other)	0.00	0.18	.996	−0.11	0.19	.555	−0.07	0.19	.705	−0.20	0.19	.289
Factor ③ Factor 3: Self-efficacy												
Self-efficacy (=other)	0.00	0.18	.991	−0.04	0.18	.834	0.32	0.17	.060	0.32	0.17	.065
Factor ④ Factor 4: Social climate for gender roles												
(4a) Gender equality				0.02	0.01	.166				0.01	0.01	.280
(4b) View of university education				0.02	0.10	.829				0.00	0.10	.979
(4c) View of intellectual women				−0.12	0.08	.126				−0.05	0.08	.516
(4d) Attractiveness to opposite sex (=disagree)				0.54	0.21	.010*				0.57	0.22	.009*
Observations	1082			1082			1082			1082		
Nagelkerke R^2	.38			.39			.38			.38		

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. SE shows standard error.


Factor
1 Masculine Culture of the Field
1a Gender Image of Occupations
1b The Mathematical Stereotype
1c Intellectual Image of the Field
1d Lack of Female Role Models
Both Mathematics and Physics
Both Mathematics and Physics
Both Mathematics and Physics
Physics Only
Factor
2 Early Experiences
2a Types of Play During Childhood
2b Pressure to Choose Between Science or Humanities
Factor
3 Gender Gaps in Self-Efficacy
(Cheryan et al., 2017)
NEW!
Expanded Model Based on Our Research
Factor
4 Social Climate Surrounding Gender Roles
4a Gender Roles
4b Views Regarding University Education
4c Views Regarding Intellectual Women
4d Perceived Attractiveness to the Opposite Sex
Mathematics Only
Both Mathematics and Physics
Masculine Perception of Mathematics and Physics

6. Information provision（情報提供）

Ikkatai, Y., Inoue, A., Minamizaki, A., Kano, K., McKay, E., & Yokoyama, H. M. (2021). Effect of providing gender equality information on students' motivations to choose STEM. *PLOS ONE.*

(A) STEM Occupations

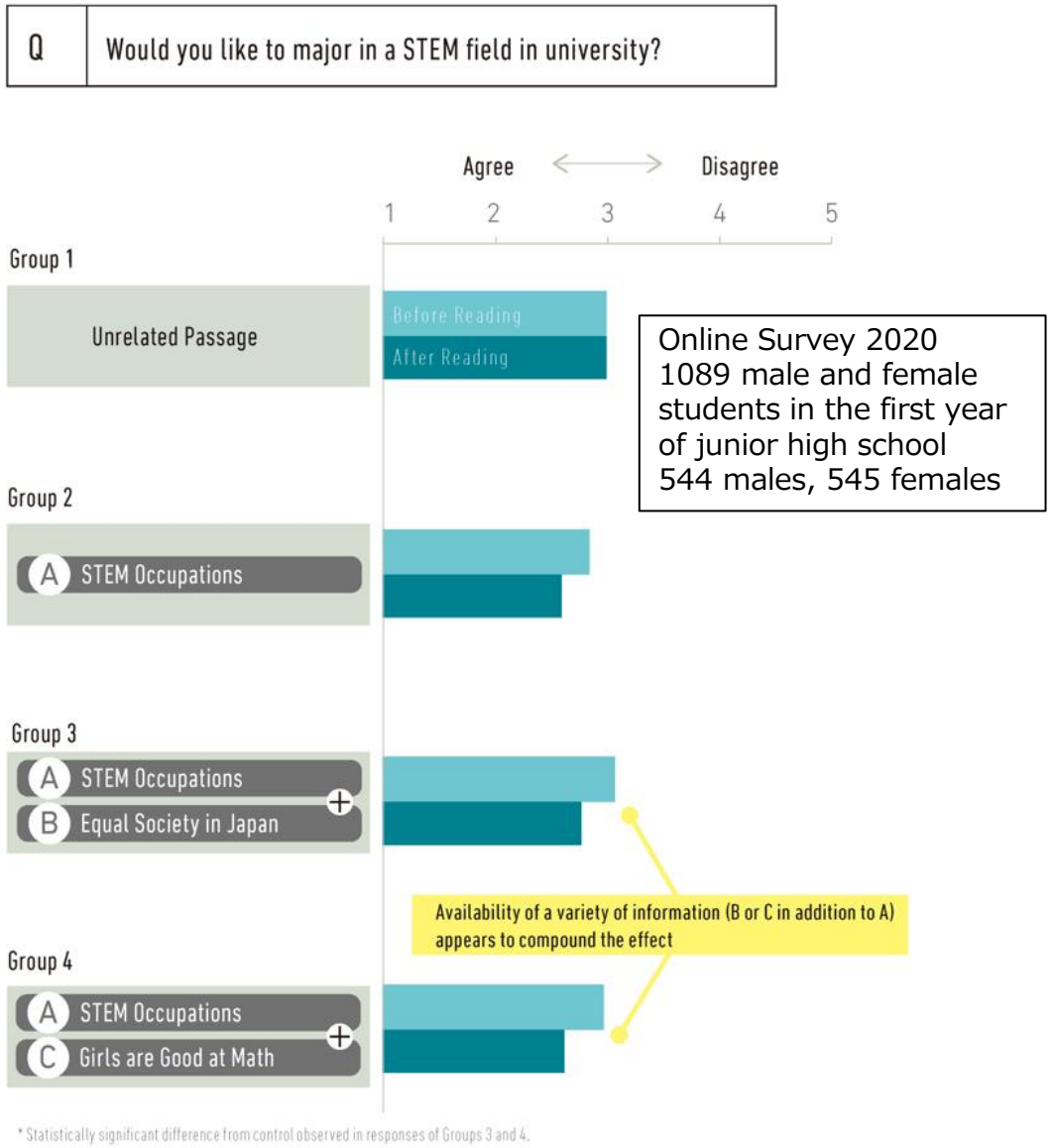
This passage outlined the plentiful career opportunities available to STEM majors. In particular, it detailed the involvement of graduates with backgrounds in mathematics and physics in the burgeoning field of AI. The passage also discussed the current scarcity of women in STEM majors despite high demand for graduates, and the hope that more women will choose to specialize in these fields in coming years.

(B) Equal Society in Japan

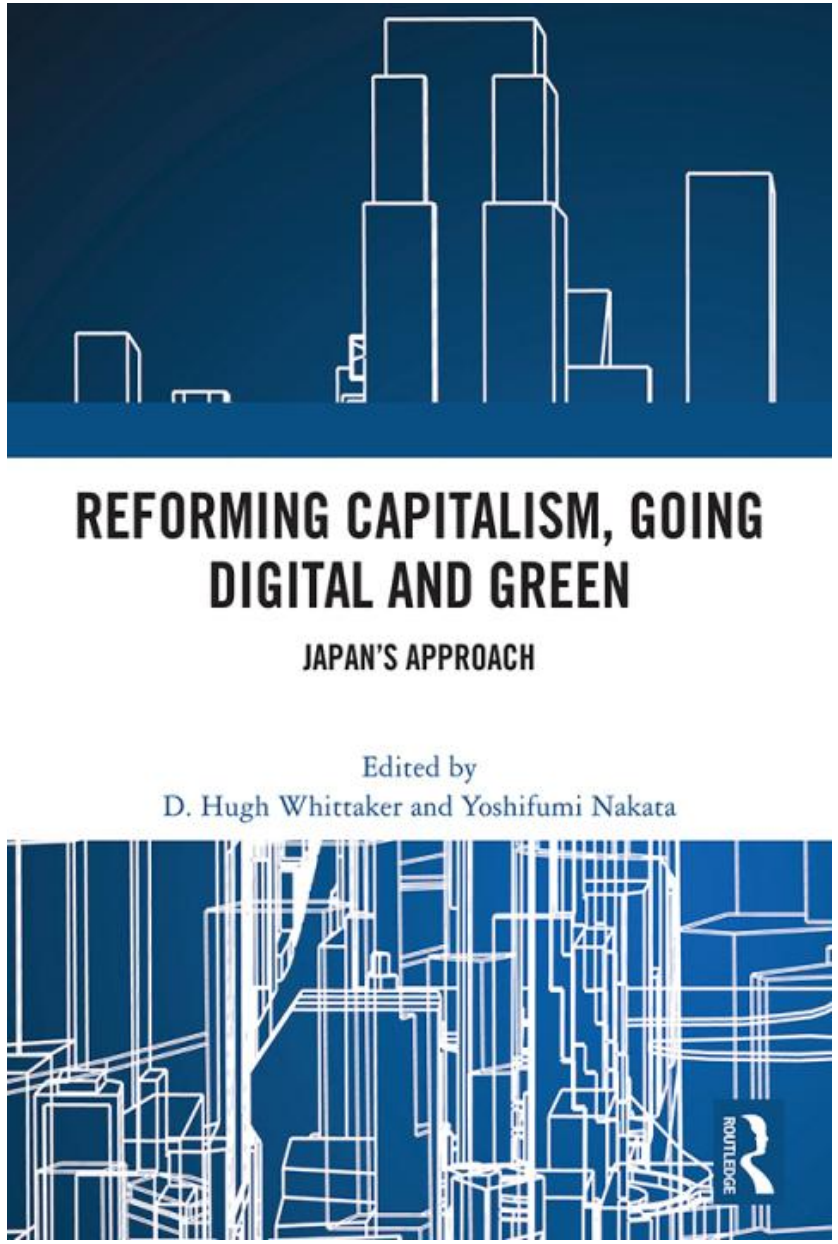
This passage explained why economic independence is a vital component for women in achieving social equality and the freedom to live life as they wish. It highlighted some of the ways in which corporate environments are changing so that both women and men are able to lead fulfilling, sustainable careers.

(C) Girls are Good at Math

This passage demonstrated that there is no difference between women and men when it comes to mathematical aptitude. It shared the fact that girls in Japan score exceptionally well in mathematics, and that boys do similarly well. In fact, in international surveys, Japanese students, both boys and girls, have some of the best mathematics scores in the world.



Online Survey 2020
1089 male and female students in the first year of junior high school
544 males, 545 females



Women’s quota

- **[Women in STEM]** Hiromi M. Yokoyama, Yuko Ikkatai, Euan McKay, Atsushi Inoue, Azusa Minamizaki & Kei Kano (2024) Can affirmative action overcome STEM gender inequality in Japan? Expectations and concerns, Asia Pacific Business Review, DOI: 10.1080/13602381.2024.2320547
- Summary of our past papers and discussion on the women's quota
- Concerns that the quotas available to women only reinforce the incorrect stereotype that women can't do science

8. Comparative Advantage(比較優位説)

The Comparative Advantage Thesis Revisited: Score in Maths for Girls and Science for Boys Influence STEM Choice Preliminary / submitted

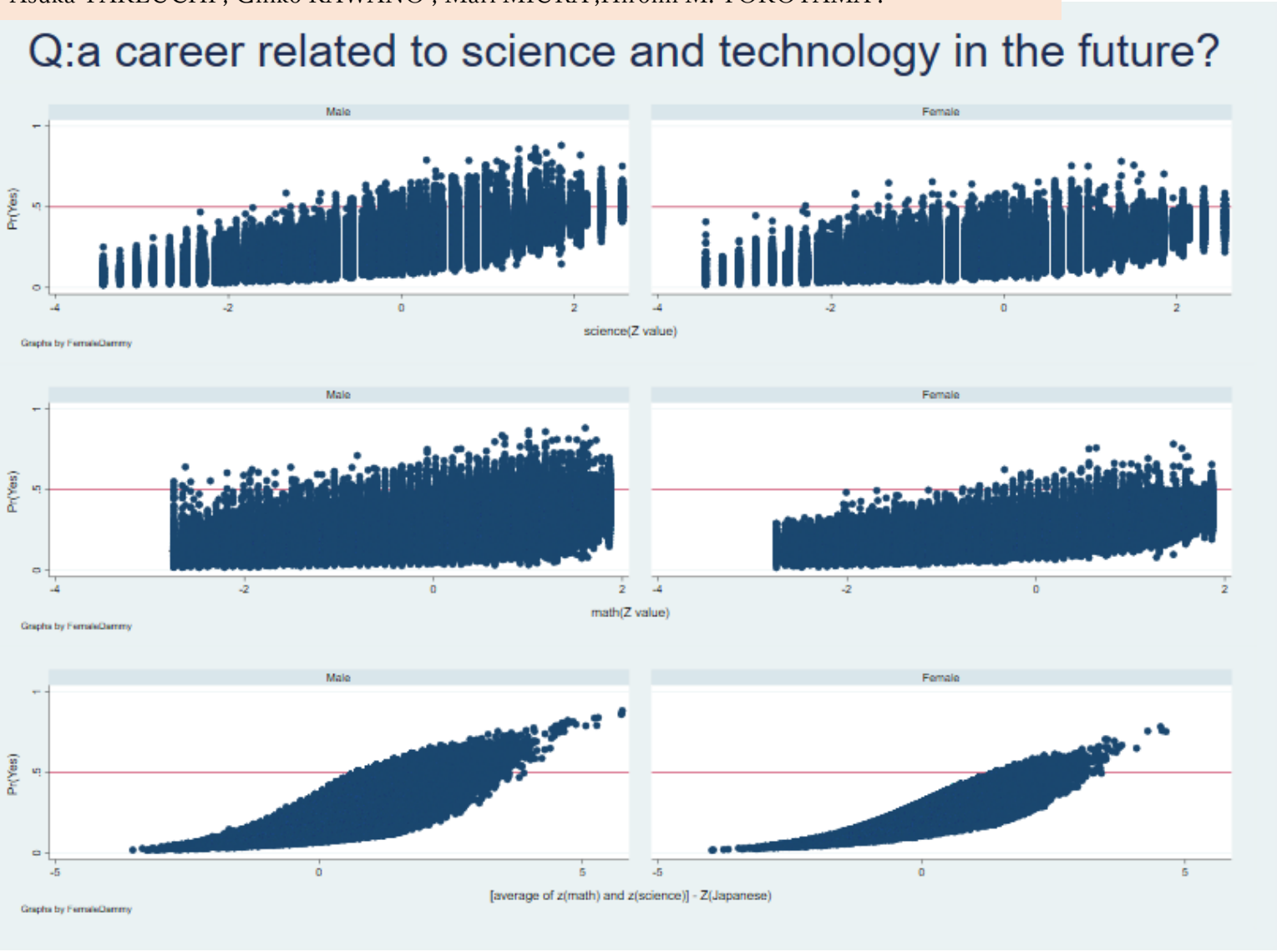
Asuka TAKEUCHI , Ginko KAWANO , Mari MIURA ,Hiromi M. YOKOYAMA .

Using approximately 1 million test data from 3rd year junior high school students

1. Math, Science and Japanese: all scores
girls > boys

2. (Math + Science) -2 x Japanese
＞boys are positive
＜girls are negative

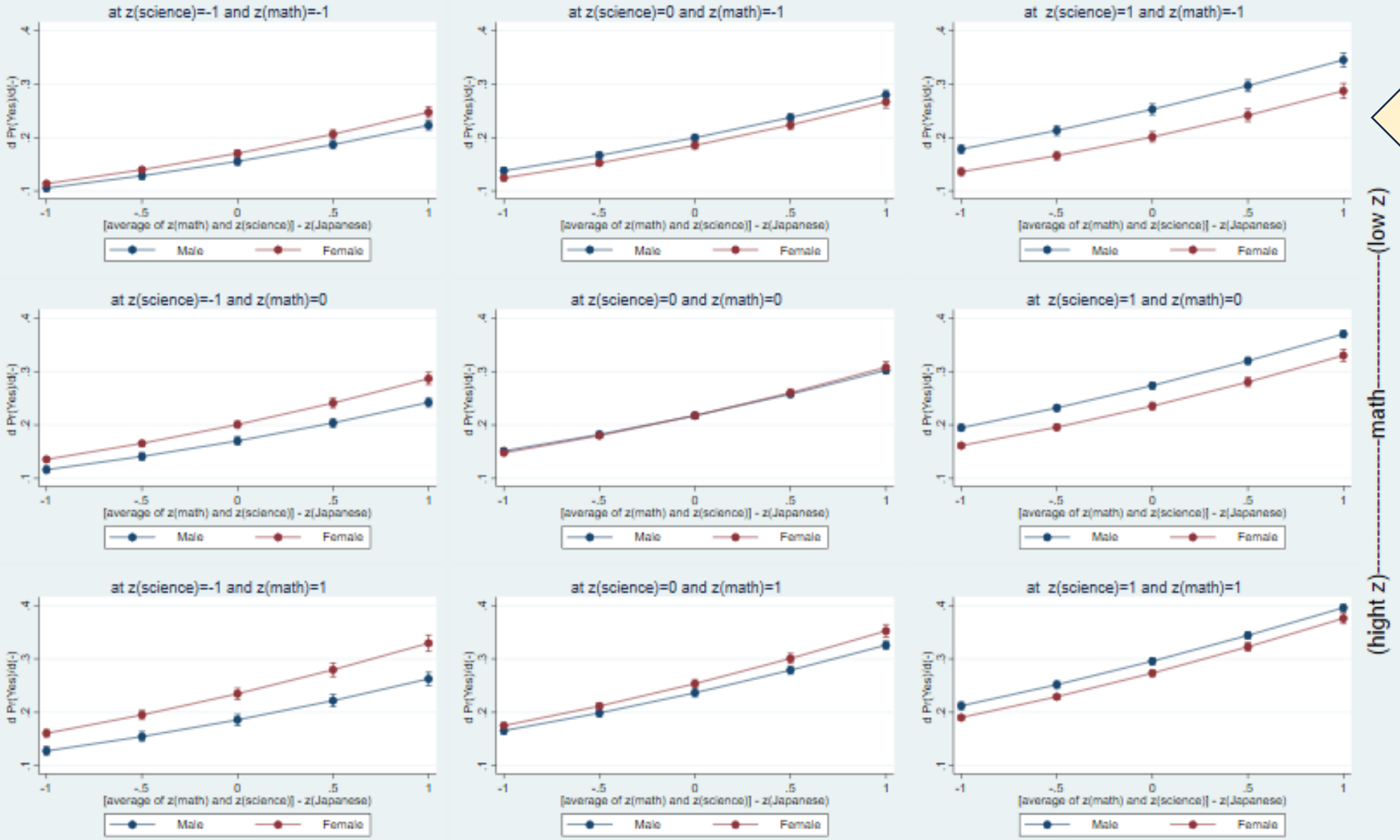
Z-values in
Maths for Girls and
Science for Boys Influence
STEM Choice(Y)



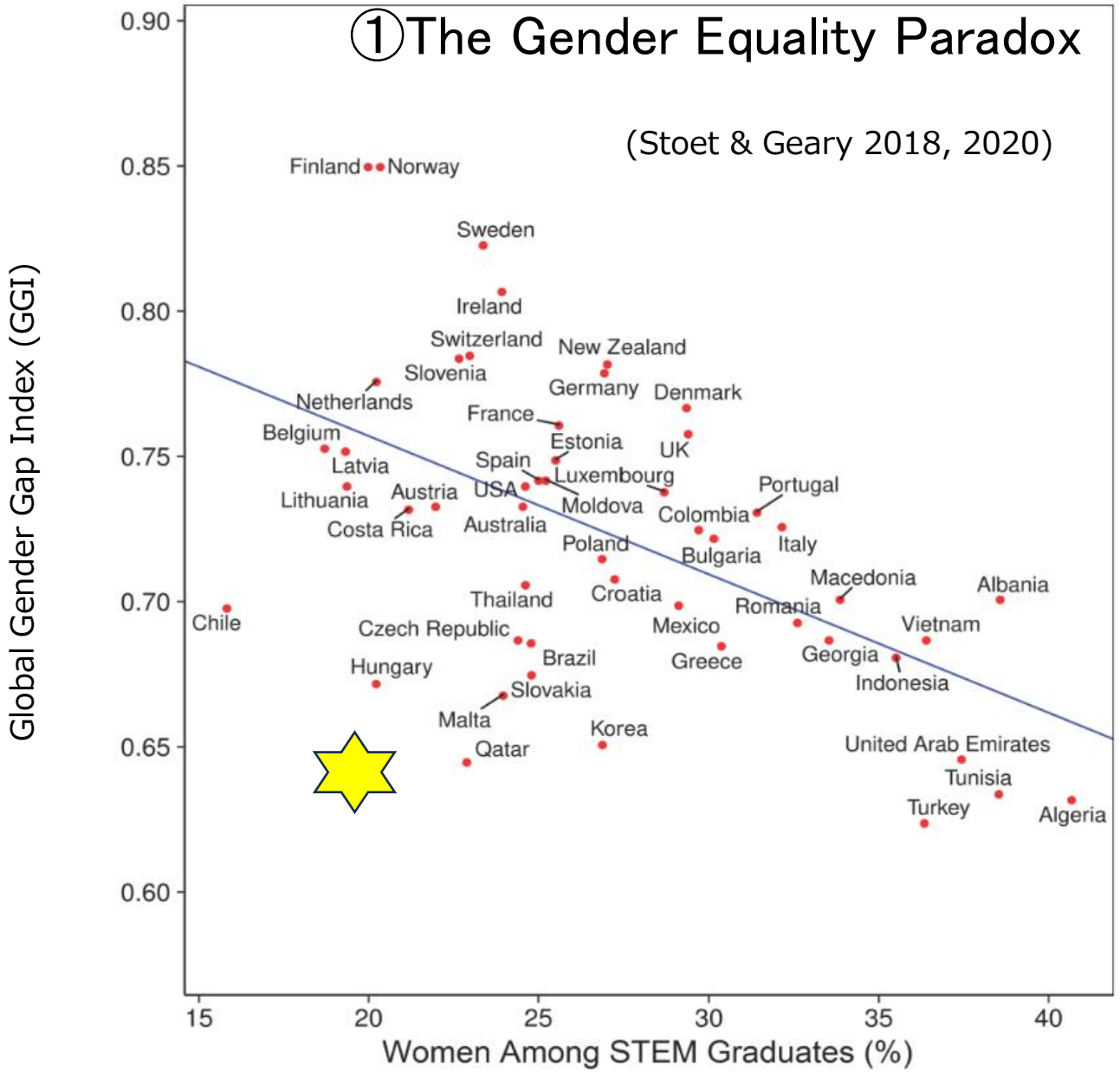
a career related to science and technology in the future?

Marginal Effect under the condition of z(science) and z(math)

Preliminary / submitted



Remaining Mysteries



②Is it true that girls hate science and math?

- Junior high school girls “pretend" their dislike of science and mathematics (Uchida & Mori 2012).

Summary

To restore research competitiveness

- Most importantly, improving the environment

For female students to enter the sciences and technology

- Our study revealed that the social climate influences the masculine image of mathematics and physics.
- Providing information: equal information and denial of math stereotypes are important.
- It is important to encourage girls who like science to pursue STEM pathways. In fact, since we also want to see more boys in these fields, fostering an interest in science among boys is also a key policy issue.

Science of Science Communication

- As STS research field, we can research it for making evidence related “S&T Innovation policy” and ”Science of Science Communication“.