Urban-Rural Distinction in Gender-Science Stereotype: Background, Causes, Impacts, and Advice

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Abstract:

Gender-Science stereotype is an important focus of social psychology and is under intensive research since the late 20th century. Different factors contribute to gender-science stereotypes, and the extent of stereotypes varies among people of different gender, ages, levels of education, occupation, and geographical background. In this research, two surveys of gender-science stereotypes involving 1,025 participants are conducted in Etown, Beijing. The participants come from urban and rural areas of Etown, respectively. In general, the explicit (self-report) gender-science stereotype is dominant in rural areas, and the implicit gender-science stereotype is similar in urban and rural areas.

Keywords:

gender-science stereotype, social psychology, gender inequality

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***Introduction*:**

The Status Quo of Gender-Science Stereotype

Gender stereotypes refer to preconceived views that assign and associate certain characteristics with men and women. In the science community, gender stereotypes that men are usually more gifted and successful than women have influenced the academic performance, participation, and interest of men and women. The effect of stereotypes has been intensively investigated since the late 20th century. Spencer et al [1] show that women perform significantly worse in math tests when they are exposed to gender stereotypes or informed that the test's focus is the gender difference in math skills. More recently, the meta-analysis conducted by Flore et al [2] and Doyle et al [3] demonstrates the negative effect of stereotype threats on women's math, science, and special skills. In order to better understand gender-science stereotypes and promote women's participation in STEM fields, recent research focus has been directed to gender-science stereotypes in higher education as well as scientific research.

Gender Stereotypes in STEM

Common gender-science stereotypes fall into three categories: The field-specific beliefs hypothesis [3], the Family-Work Balance and Lifestyle Values [4], and the association of STEM with men and muscularity [5].

In the field-specific beliefs hypothesis, STEM practitioners are suggested to hold beliefs on some innate qualities that contribute to success in their discipline, and women are believed to possess fewer gifts and characteristics that help them to succeed in STEM fields than men. In this hypothesis, women's success in scientific research and education is

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attributed to their efforts rather than talents. On the other hand, the theory suggests women need to invest additional time and effort to become as successful as men. Leslie et al [3] tested this stereotype based on the self-report of science practitioners, and an inversed relationship was shown between women's participation in the discipline and the discipline's emphasis on giftedness. In other words, women are believed to be less successful in fields that require talent and certain qualities.

The gender difference in lifestyle and family-work balance may also lead to gender inequality in STEM participation and achievements. Eccles et al. [6] suggested that compared to men, women are more likely to compromise their occupational and educational opportunities to take on family responsibilities. In STEM fields specifically, the overlap between women's optimal year of fertility and tenure pursuits leads to a view that STEM tenure-track careers are unsuited to achieving their family goals [4,7]. As a result, women may seek flexible academic positions at higher rates than men, and women are often underrepresented among full-time professors/researchers but overrepresented among instructors and lecturers.

The association of STEM with men and muscularity suggested that STEM practitioners process more muscular and male characteristics. For instance, some STEM institutes and companies may prefer males over females even though the candidates have similar skills and other backgrounds. A meta-analysis conducted by Noesk et al. [8] confirmed this stereotype and its vast influence in all 34 countries of study. In the Raewyn Connell model [9], men as the overrepresented gender have more public influence, which makes the public associate male and muscularity with STEM. While women are

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underrepresented, this association further enhances the gender stereotype and men's public influence.

Hypotheses of Regional Difference in Gender-Science Stereotype:

Compared to rural communities, Urban communities are characterized by higher income levels, more educational opportunities (and, as a result, occupational opportunities), broader access to information and technology, and relatively high population mobility. All of the factors result in the different prevalence of gender-science stereotypes between urban and rural communities. As the urban-rural difference in gender-science stereotype is a rarely studied topic, we hereby made the following analysis and tested them in 2 studies.

To become successful in research or other STEM-related occupations, students will require high expertise in the field. Many STEM career paths require at least a bachelor's degree in science. Apprenticeship and undergraduate research opportunities also provide students an advantage when they compete for the job. While the gender gap in education exists in both urban and rural populations, the average duration of schooling in rural areas is far shorter than in urban areas. For example, urban Nepalese on average have 3 more years of schooling than rural Nepalese [10], and the gender gap in education is less than a year. In China, not only do urban students enjoy longer education duration, but they also exhibit better overall academic performance [11]. The regional education gap, along with the gender gap in education, leads to decreased education opportunities for women in rural areas. With all these factors limiting their success in STEM fields, women in rural areas may be viewed as "incapable" and "untalented", which leads to the field-specific beliefs stereotype.

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The field-specific belief hypothesis should be therefore more implicit in urban communities.

It is traditionally and stereotypically believed that women undertake more family responsibilities. In China, the women's labor force participation rate (LFPR) in urban areas is in continuous decline for the past decade [12]. In India, urban women participate in work at a 30% lower rate than women in rural areas [13]. While urban women's LFPR is lower than rural women's LFPR, a study by Ebrahim on Iranian women [14] also suggested a negative relationship between the number of children and the labor force participation rate. Rural areas have a higher average fertility rate, and rural women's passion for work is more affected by family responsibilities. Therefore, rural women are also susceptible to the family-work balance stereotype.

The third stereotype that associates STEM with muscularity is formed when there is no counter-example. This association enhances stereotypes, as explained by Greenwald et al.'s unified theory [14]. According to this theory, a stereotype is the association between a group concept (e.g., men) with a given attribute concept (e.g., STEM) [15]. An important principle of this theory is that the association between two (initially) unlinked concepts (e.g., women and STEM) can be created and reinforced if these concepts share a common association with a third concept (e.g., the self) [15]. The presence of women scientists and family STEM backgrounds can reinforce the women-STEM association, which counters the stereotypical men-STEM association. More scientists and researchers come from urban areas, so the urban population enjoys this information and background advantage. They are more aware of women's scientific achievements and examples of female scientists around them. The men-STEM association stereotype is therefore supposedly weaker in urban areas.

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Method:

To study the three types of gender-science stereotypes in rural and urban areas of Etown, 2 studies are performed. Both studies are based on explicit self-reports. Study 1 is conducted in institutes, business sectors, traffic centers, and downtown residential areas of Etown and involved 210 participants. Study 2 is conducted in suburban zones of Etown and involved 815 participants.

Study 1

A field investigation is conducted in downtown areas of Etown. Selected locations include the Han's Plaza (a business and traffic center), Etown Biomedical Park (a biotech research complex), Beijing Etown Academy (an institute), and 2 local neighborhoods. Participants were invited to fill out a survey containing basic background information (age, education level, academic field of study/occupation) and questions specifically about their opinion on the three types of gender-science stereotypes identified previously. Additionally, participants are asked to evaluate the difficulty and their interest in natural sciences, social sciences, and arts. Then, the participants evaluated 3 statements about the 3 different stereotype types. The responses were collected with consent for research and publication use.

Study 2

A field investigation is conducted in rural areas of Etown and DaXing district. Selected locations are outside of the 6^{th} ring road and are at the boundary of the district. The survey is distributed via QR codes and in-person investigation. Participants were invited to fill out the same survey in study 1 and answer the same questions in study 1. Participants were

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given a small amount of economic incentive. The responses were collected with consent for research and publication use.

Results and Discussion:

Participants	Urban-male	Urban-female	Rural-male	Rural-female
Average age	34.19	30.83	26.30	26.74
Average years of schooling*	16.01	16.36	11.24	10.95
Expected years of schooling	19.60	19.90	15.59	15.53
STEM ratio**	56.16%	40.88%	30.89%	18.93%
Stereotype 1***	15.07%	5.84%	61.54%	56.57%
Stereotype 2	63.01%	77.37%	56.90%	70.61%
Stereotype 3	31.51%	48.18%	51.36%	52.55%
Overall stereotype	36.53%	43.80%	56.60%	59.91%

*: Evaluated based on education background

**: Participants who identify their academic field/occupation as STEM-related

***: Participants who exhibit the field-specific beliefs hypothesis stereotype. Stereotype 2 is the Family-Work Balance stereotype, and Stereotype 3 is the STEM-male association stereotype.

Fig.1 Percentage of participants who exhibit certain types of gender-science stereotypes.

The results of both studies were collected and presented in figure 1. The background research shows a ~5-year gap between the urban and rural education duration, and the gender gap in education is trivial. The gender gap in the STEM participation rate is apparent in both rural and urban areas. Limited by education resources, financial conditions, and family support, the STEM coverage in rural areas is ~20% lower than in urban areas. Women from rural areas are significantly underrepresented in the science community. As

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predicted by the hypothesis, rural residents exhibit ~18% higher overall levels of stereotypes. The field-specific beliefs hypothesis stereotype is significantly more often exhibited by rural populations. The Family-Work Balance stereotype is more prevalent in urban areas by a marginal 7%. The STEM-male association stereotype in urban female, urban male, and rural female are relatively equal; Urban male has ~19% lower frequency of exhibiting this stereotype.

Subject	Urban-male	Urban-female	Rural-male	Rural-female
Natural sciences	6.81 (+0.10)	7.11 (+0.47)	7.05 (+0.21)	6.77 (+0.04)
Social sciences	6.75 (+0.04)	6.39 (-0.25)	6.72 (-0.12)	6.88 (+0.15)
Arts	6.58 (-0.13)	6.42 (-0.22)	6.74 (-0.10)	6.55 (-0.18)
Average	6.71	6.64	6.84	6.73

Fig.2 Participants' self-evaluation on the difficulty of different subjects

An interesting trend is observed when we analyze participants' self-reported difficulty on different subjects. Participants evaluate the difficulty of natural sciences, social sciences, and art subjects based on a 1-10 scale, where a larger number represents a higher difficulty level. Rural populations report a higher overall difficulty in all subjects. If we observe the difference between the average difficulty index and the difficulty index of a specific subject, the urban-rural distinction in STEM subjects is vast. Urban females view STEM subjects as more difficult by +0.47 to the average, while urban males and rural females only exhibit the slightest level of STEM-phobia (+0.10 and +0.04 respectively). Rural males also believe STEM is more difficult by a considerable +0.21. If we believe the self-reported difficulty highly relies on the participant's talent and skills in the specific field, this is inconsistent

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with the results of stereotype 1 (the field-specific beliefs hypothesis). Despite being less identified with the field-specific beliefs stereotype, urban females believe natural sciences are more difficult than urban males do. A contrary trend is observed in rural areas, where females deem natural science easier.

Conclusion and Advice to Counter Stereotype:

The urban-rural distinction in gender-science stereotypes is vast. The field-specific beliefs stereotype is significantly more prevalent in rural areas. The family-work balance stereotype is marginally less prevalent in rural areas. The STEM-male association is marginally more prevalent in rural areas. However, considering the alarmingly low STEM coverage in rural areas (only half of that of urban) and the high gender disparity in STEM participation, resolving the gender stereotype issue is an imperative step to achieving equality in the STEM community.

A variety of factors lead to the disparity in STEM participation. Compared to urban populations, rural populations lack education resources and parental support. While the former is apparently acknowledged by the public, the latter often plays a hidden yet influential role in children's STEM development [16]. However, the educational background of rural families is limited by the lack of resources. The overall STEM atmosphere in rural areas is not visible, and STEM is not a favorable career choice for rural children.

This stalemate can be resolved by collective effort. The "hardware" problem can be improved by government support. The "software" problem, which is the influence of stereotypes, shall be properly addressed. Promotion programs are useful to disseminate the

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voice and story of female scientists, which will encourage more girls to take a STEM path. Propaganda on counter-stereotypical figures is highly encouraged because they help eliminate both the field-specific beliefs stereotype and the STEM-male association stereotype.

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