Publishing and Parenting in Academic Science: A Study of Different National Contexts

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Abstract

In the first cross-national, mixed-methods study on gender, family, and science, the authors examined the relationship between research productivity and family life for male and female physicists and biologists in four countries: India, Taiwan, the United States, and the United Kingdom. Drawing on surveys of 5,756 respondents and follow-up interviews with 369 participants, the authors found that the relationship between family responsibilities and publishing operates differently for men and women. Additionally, this relationship is conditioned by the national context in which the scientists work. The interviews indicate that family responsibilities constrain women’s publication productivity according to context. Cross-contextual differences are partially explained by the macro-level gender norms transmitted to academic scientists and how women navigate their scientific research productivity and family responsibilities. The findings have implications for the broader literature on the dialectical relationship between macro-level gender norms and responses by scientists in India, Taiwan, the United States, and the United Kingdom.

Keywords

science, gender, mixed methods, cross-national comparison

Women, in general, face greater difficulties in publishing their research in the global academic scientific community (Larivière et al. 2013) because of the interaction of institutional arrangements in academic science (Winslow and Davis 2016) and the social and cultural gender norms where they work (Ridgeway and Correll 2004). For example, it is more difficult for women scientists to collaborate internationally than it is for men (Zippel 2017), and their difficulties are more salient in contexts that endorse traditional gender norms (Campion and Shrum 2004). Given that gender inequalities are differently manifested in distinctive national contexts (Chafetz 1984; Wharton and Blair-Loy 2002), it is reasonable to suppose that the reinforcement of gender inequalities in academic sciences varies according to country. Yet few studies have offered a systematic comparison of cross-national differences.

In this article, we focus on whether and how the relationship between academic productivity and family responsibilities for biologists and physicists differs in India, Taiwan, the United States, and the United Kingdom. Although our survey data illustrate the cross-contextual variations in this relationship, our interview data suggest that family responsibilities exert distinctive constraints on women according to national context. We propose, therefore, that cross-contextual variations can be attributed partly to how macro-level gender norms are transmitted to academic scientists and how women navigate— or can navigate—between family responsibilities and scientific research. Thus, the present study provides a context-sensitive understanding of the relationship between family responsibilities and the gender publication gap in science. Our findings have implications for future analysis of gender inequalities in science and other professions.

Institutional Arrangements, Family Responsibilities, and Research Productivity

Studies in different disciplines and national contexts reveal that women, on average, are less likely than men to publish as principal investigators or sole authors (Odic and Wojcik 2020), publish in prestigious journals (Nielsen 2017), publish as principal investigators or sole authors (Odic and Wojcik 2020), publish in prestigious journals (Nielsen 2017), and

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receive fewer citations from their publications (King et al. 2017). The disadvantages for women in publication can be attributed to macro-level gender norms: the taken-for-granted cultural beliefs that men and women have different personality traits, which shape the understanding and enactment of gender ( Ridgeway and Correll 2004).

Such cultural beliefs about gender are distinctive across different contexts. In the United States and United Kingdom, gender essentialism, a cultural belief that portrays men as assertive and forceful and women as caring and expressive, is widely shared ( Crompton and Lyonette 2005; Ridgeway 2011). In India, macro-level gender norms are entwined with the authority of the family, parental power, pressure to marry, and influence of parents-in-law ( Gupta and Sharma 2002; Riessman 2000). Similarly, in Taiwan, macro-level gender norms, to some extent reinforced by Confucian values, limit some women to the domestic sphere and the authority of the extended family, especially senior members within families ( Gu 2019; Yu 2006). Although the content of macro-level gender norms differs according to context, they all privilege men, if in different ways ( Chafetz 1984).

Institutional arrangements in academic science further interact with these macro-level gender norms, raising specific obstacles for women by disadvantage, marginalizing, and excluding them throughout their careers ( Barnes and Beaulieu 2017; Gersick, Bartunek, and Dutton 2000; Miller and Roksa 2020; Winslow 2010; Winslow and Davis 2016). In graduate school, for example, women may be reluctant to speak in research meetings, have fewer collaborations with male colleagues, be less likely to have collegial relationships with their academic advisers, and be assigned more administrative work in the lab ( Fox 2001; Miller and Roksa 2020). When moving to postdoctoral or tenure-track positions, women may experience biased evaluations because they are viewed as less competent than their male colleagues ( Eaton et al. 2020; Rivera 2017).

After receiving tenure-track jobs or their equivalent, some women are excluded from networking (van den Brink and Benschop 2014) and have limited access to international conferences ( Acker and Armenti 2004). They also tend to spend more time on service obligations ( Guarino and Borden 2017) and teaching ( Hart and Cress 2008), which are valued less than research is for tenure evaluations ( Bellas 1999; Laube et al. 2007; Winslow 2010). Although some scholars argue that gendered differences in time allocation are attributed to women’s preferences ( Ceci and Williams 2011; Wolfinger, Mason, and Goulden 2009), others say that men and women value research hours equally ( Winslow 2010), even though women receive unequal teaching and service assignments ( Hart and Cress 2008; Laube et al. 2007; Misra, Lundquist, and Templer 2012).

Disciplinary differences further complicate the reinforcement of gender inequalities in academic science. In many national contexts, there are more women in biology than physics ( Ceci et al. 2014; Cheryan et al. 2017; Ecklund, Lincoln, and Tansey 2012; Gautam 2015; Pyke 1999; Wang and Stocker 2010), which translates to different disciplinary cultures. Physics is perceived as a “masculine” discipline, being mathematical and rational ( Cheryan et al. 2017; Gonsalves, Danielsson, and Pettersson 2016), whereas biology is perceived as “feminized” and easier in which to achieve a work-life balance ( Cheryan et al. 2017; Ecklund et al. 2012). Such cultural differences motivated this study to include both disciplines.

Like gender inequalities in other social institutions ( Fuwa 2004), gender inequalities in academic science are produced by the interaction of social gender norms in different countries and their institutional arrangements. Academic science, like many other global professions ( Wharton and Blair-Loy 2002), disadvantages women through similar institutional arrangements across contexts ( Larivière et al. 2013; Zippel 2017). Yet there are still cross-contextual variations in the reinforcement of gender inequalities. Hence, to understand women’s productivity in academic science, it is important to situate gender, family, and science in their respective contexts.

**Gender, Family, and Science in the Cross-National Context**

In India, women in science encounter gender discrimination, experience tensions between work and family, have limited network access and lack sufficient opportunities for travel ( Campion and Shrum 2004; Gupta 2007, 2017; Gupta and Sharma 2002). Although gender inequality has a similar manifestation in other contexts, some scholars argue that it is India’s cultural and social norms that perpetuate gender inequalities there ( Gupta 2017; Gupta and Sharma 2002; Subrahmanyan 1995). Families in India, for instance, have considerable authority, which constitutes a core value of “Indianness” ( Chanana, Karlekar, and Ulrich 1994; Gupta 2017). Decisions about marriage ( Desai and Andrist 2010) and women’s access to education ( Gupta and Sharma 2002) are usually family decisions, and many Indian families do not want their daughters to have an advanced education because it may limit their opportunities to find well-educated older husbands ( Chanana et al. 1994; Gupta and Sharma 2002; Subramanian 2007). Still, beginning in the 1990s, thanks to economic liberalization and new forms of work and consumption, an increasing number of Indian women study STEM subjects ( science, technology, engineering, and mathematics ) ( Radhakrishnan 2009). Although some women in sciences in India receive help with childcare because of their close connections with extended families ( Subrahmanyan 1995), many do not want to sacrifice family responsibilities, including childcare and eldercare ( Grover, Samantroy, and Paiva 2015; Radhakrishnan 2009).

In Taiwan, women began entering science in the 1950s, a development attributable to the Taiwanese government’s financial investment in science and technology at that time.
(Wang and Stocker 2010). Becoming a scientist was, and is, an important pathway for Taiwanese women to achieve upward social and economic mobility (Wang and Stocker 2010). However, female scientists are better represented in the life sciences than in the physical sciences (Science and Technology Division in Taiwan 2016; Wang and Stocker 2010). Like their colleagues in India—though there are differences—Taiwanese women value family authority, especially the opinions of their parents-in-law, and filial piety is a core belief in Confucianism (Tsai 2006; Yan 2011). However, the role that family, including extended family, plays among Taiwanese women can be ambivalent. According to a survey of Taiwanese women working in physics, family responsibilities affect their productivity and can lead to their departure from research (Wu 2002), even though the studies show that Taiwanese grandparents often help care for their grandchildren (Chan et al. 2019).

The interaction between macro-level gender norms and institutional arrangements in science in the United States differs again. Since the 1960s, the norm of male primacy has declined (Charles and Grusky 2005), but gender essentialism—the cultural belief that men are forceful and assertive and women are kind and caring—remains broadly accepted (Ridgeway 2011). Gender essentialism not only describes the family as the woman’s responsibility (Bianchi, Robinson, and Milke 2006) but also limits women’s entry into scientific disciplines that rely heavily on mathematics (Breda et al. 2020). U.S. women still need to overcome considerable obstacles to enter the “hard” sciences, especially physics (Breda et al. 2020; National Science Board 2016). They continue to reconcile work and family obligations throughout their careers, from early job seeking (Rivera 2017) to pretenure and tenured positions (Misra et al. 2012; Rothausen-Vange, Marler, and Wright 2005). For example, women at research-oriented universities are less likely than men to have a family, face greater pressure to be productive (Rothausen-Vange et al. 2005), have less access to international conferences because of caretaking responsibilities (Acker and Armenti 2004), and face more obstacles moving to full professorships (Misra et al. 2012).

To some extent, gender, family, and their relationships to academic science in the United Kingdom resemble the normative constructions in the United States. Beginning in the 1970s, women’s participation in the labor market in the United Kingdom increased steadily (Machin 1996), but gender essentialism persists as a widely shared gender norm there (Crompton and Lyonette 2005), as it does in the United States. It is therefore unsurprising that inequalities in science persist in the United Kingdom. Female scientists, for example, are disproportionately underrepresented at universities that score high on the Research Excellence Framework and at which there are positions that offer support for publishing (Ashencaen Crabtree and Shiel 2019). Like their colleagues in other contexts, U.K. female scientists struggle to balance work and family (Kinman and Jones 2008), even though the U.K. government and universities provide support for childcare, such as maternity leave (Ledwith and Manfredi 2000; U.K. Government n.d.). Nevertheless, childcare policies center on children rather than women, and long-term maternity leave, however well intended, can disadvantage women’s careers by excluding them temporarily from research (Lewis and Campbell 2007).

Although family responsibilities often disadvantage women’s productivity across contexts, they do so particularly with publication productivity. Although the authority of the family is not deeply entrenched in gender norms in the United States and the United Kingdom, it is important to note that female scientists there, like their colleagues in other industrial societies (Etzkowitz and Kemelgor 2001), may receive only limited childcare support from extended families.

**Data and Methods**

Data for this study come from a broader project examining the social influences on scientific work for physicists and biologists in France, India, Italy, Taiwan, Turkey, Hong Kong, the United States, and the United Kingdom. To select a survey sample, we generated an organizational-level sampling frame of universities and research institutions that host biology and physics departments in these countries. Second, we stratified this organizational sampling frame on the basis of discipline (biology and physics) and elite status.1 We relied on department Web sites to construct an individual-level sampling frame, stratified the individual-level sampling frame by rank and gender, and implemented the survey. In this broader study, 9,422 respondents completed the survey, with response rates ranging from 39 percent in Turkey and Taiwan to 57 percent in Italy and the United States (Ecklund et al. 2016).

In the present study we consider India, Taiwan, the United States, and the United Kingdom for their similarities and differences in (1) science and technology research and development infrastructure and (2) attitudes toward women’s positions in the family and the workplace. According to the National Science Board (2016), as of 2013, research and development (R&D) expenditures were approximately $36.2 billion in India, $30 billion in Taiwan, $457 billion in the United States, and $40 billion in the United Kingdom. Using R&D expenditure as a measure of science research and development infrastructure, India and the United Kingdom are similar, and the United States and Taiwan markedly different. We also selected these countries on the basis of the attitudes of physicists and biologists toward women’s positions in the family and workplace. From our broader survey, we found that the United States and the United Kingdom are most alike concerning gender ideologies, and India is similar

1The decision of elite status was made on the basis of the number of publications, university rankings, and insider opinions.
to Taiwan in this respect. Although hardly exhaustive, selecting the most similar and most different countries on the two key dimensions—R&D and attitudes to women in the workplace—allowed us to unpack nuanced and salient cross-contextual differences.

In the four contexts, 6,018 physicists and biologists completed the surveys. We excluded 262 responses with missing data for gender, which yielded a total sample size of 5,756 for quantitative analysis. Women accounted for 34 percent of respondents in India, 32 percent in Taiwan, 32 percent in the United States, and 38 percent in the United Kingdom (Table 1).

Survey respondents were asked if they would agree to be interviewed. We then generated an interview sampling frame, selecting respondents according to institutional status, discipline, gender, and career stage. We conducted 369 interviews: 80 in India, 52 in Taiwan, 100 in the United States, and 137 in the United Kingdom. Table 2 shows the demographic characteristics of the interview respondents.

During the interview, we asked, “Compared to men, do you think it’s more difficult for women to be successful scientists?” All but two associated “success” with “productivity and achievement.” Because we use the interview data to understand how and why cross-contextual differences emerged in our survey data, we focused on explanations by the respondents of the relationship between family responsibilities and women’s achievement and productivity in science. Women’s family responsibilities are also the most common theme across all four contexts. Narratives from both men and women are included in this analysis because they both sustain and challenge gendered structures in science.

All interviews were fully transcribed. We used a two-cycle strategy for analyzing the interview data (Saldana 2015). In the first round, we identified emerging themes from each country and generated for each country a coding scheme. In the second, we categorized the interview data into a coding scheme. This approach allowed us to highlight the modified inductive nature of the qualitative data and to analyze it systematically.

### Survey Variables and Quantitative Strategy

Our outcome variable is a measure of the number of reported publications. Loosely following the 2004 National Study of Postsecondary Faculty (Cataldi, Bradburn, and Fahimi 2005), our survey asked respondents to “indicate the number of your writings (solo or co-authored) published or accepted for publication in the past 3 years in refereed journals, not counting abstracts.” As prior research reveals a highly skewed distribution of faculty publication (Fox 2005), we offered categorical responses on an ordinal scale including 0 = “none,” 1 = “1 to 3,” 2 = “4 to 6,” 3 = “7 to 10,” 4 = “11 to 20,” 5 = “21 to 50,” 6 = “51 to 100,” 7 = “101 to 200,” and 8 = “more than 200.”

In our analysis, we included a set of family-related variables, such as marital status (married = 1), parental status (parent = 1), and a measure of work-family strain. We...
measured the latter by asking, “In the past three months, how often did you have insufficient time for your family (however you define it) because of your job?” Responses ranged from 1 = “never” to 5 = “very often.” We also included a set of career-related variables that might be related to publication productivity, such as research funding (1 = no funding), rank (1 = graduate student, 2 = midcareer scientist, 3 = senior scientist),3 and elite status of the institution (1 = elite). Finally, we controlled for whether the scientists had at least one parent with a college degree (parent degree = 1), racial status (racial minority = 1),4 and nativity (immigrant = 1). To identify how the relationships between family responsibilities and publication productivity operate for men and women, we constructed interaction terms between gender and all family-related measurements. Finally, to account for interdisciplinary differences, we modeled physics and biology separately.

Findings

Gender Gaps in Global Physics and Biology

Physics. We report key results for ordinary least squares models regressing publications among physicists across the four regions in our study in Table 3 (see full results for each region in Supplemental Tables 1 through 4). Net of controls, female scientists in India published significantly less than male scientists, having reported a .354 lower publication score (model 1). Results further revealed that Indian parents reported .568 higher publication scores than nonparents, and the interaction between gender and parenting was negative and significant (model 3). This means that in India, fathers in physics appear to enjoy a publication boost compared with men without children, but mothers in physics seem to suffer a publishing penalty relative to fathers.

Although we did not observe a gender gap in publishing in our baseline models for the other three regions, interaction models revealed significant patterns in two of them. In Taiwan, married female physicists reported a .789 lower publication score than their married male counterparts (model 2), and mothers reported a 1.018 lower publication score than fathers (model 3). In the United States, female physicists reported a .822 higher publication score in model 4, but female physicists who experienced work-to-family strain reported a .232 lower publication score than their male counterparts (model 4). In other words, although these results suggest the gender publication gap, in general, is not as salient in the United States as it is in the other contexts studied, among those who experience conflict between work and home, the publishing climate in the United States is less favorable for women than men.

Biologists. As indicated in Table 4, we more consistently observed gender differences in publishing among biologists compared with physicists, despite greater representation within biology departments. In baseline models (model 1), female biologists reported .332 and .508 lower publication scores than male biologists in India and Taiwan, respectfully. In the latter, married biologists reported .361 higher publication scores than nonmarried biologists (model 2), but married female biologists reported .374 lower publication scores than married male biologists. This suggests a marital reward in publishing for men but not women in Taiwan. That said, women who experienced work-to-family strain reported a .243 higher publication score than their male counterparts (model 4), though the size of their advantage from strain remained substantively lower than the 1.357 publication score deficit female biologists otherwise reported compared with male biologists generally in the same model.

Negative coefficients for the female variable were not significant in baseline models (model 1) for biologists in the United States and United Kingdom. That said, a publishing penalty for female biologists in the United Kingdom was observed among married respondents (model 2). Specifically, married female biologists reported a .389 lower publication score than married male biologists in the United Kingdom.

Sensitivity Analyses. In preliminary analyses, we observed the distribution of the outcome variable to have a skew ranging from .6 to 1.2, with some variation by region. To check the degree to which observed patterns were sensitive to this distribution, we replicated our main analyses with a log-transformed version of the outcome variable. We added .5 to the zero score to preserve observations. Results are reported in Supplemental Tables 5 and 6. We observed substantively similar results with some exceptions. Of note, the parental bonuses among physicists in India and biologists in the United Kingdom (model 3) were not significant, nor were

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Table 2. Demographic Characteristics of Interview Respondents.

|                | India | Taiwan | United States | United Kingdom |
|----------------|-------|--------|---------------|----------------|
| Gender         |       |        |               |                |
| Men            | 76%   | 65%    | 38%           | 40%            |
| Women          | 24%   | 35%    | 62%           | 60%            |
| Discipline     |       |        |               |                |
| Physics        | 44%   | 48%    | 39%           | 45%            |
| Biology        | 56%   | 52%    | 61%           | 55%            |
| n              | 80    | 52     | 100           | 137            |

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3 Across the four contexts, 32 percent to 42 percent of the respondents in our sample are graduate students. It is important to note that the pressure imposed on graduate students may be different from the pressure imposed on scholars in their mid- to senior career stages. Although these differences are beyond the nuances this study is able to address, we invite future scholars to continue this endeavor.

4 Majority racial classifications included South Asian in India, East Asian in Taiwan, and white in the United Kingdom and the United States.
the interactions between gender and marital status (model 2) for both Taiwanese physicists and biologists. Also, among Taiwanese biologists, the interaction between gender and work-to-family strain was also not significant, and among U.S. physicists, variables for both gender and the interaction between gender and work-to-family strain were not significant.

We can draw two inferences from our main quantitative analysis. First, family-related variables are not significant in every national context and scientific discipline, but where they are significant, they penalize women but not men. Second, the specific modality of family dynamic salient for publishing varied according to context. Parenting was a significant factor in India and Taiwan, marriage in Taiwan and the United Kingdom, and work-family strain in the United States. Although survey analysis reveals general patterns, it leaves an important question: how do scientists in these different country contexts themselves perceive the relationship between family responsibilities and their own publication records? To answer this question, we turn to our interview data.

India: Compounding Gendered Expectations

In India, most respondents believed that women generally experience compounding gendered expectations: they are expected to marry in their 20s, stay at home and care for children and the elderly, and manage households. These gendered expectations frustrate women from working, let alone thriving, in science. For example, a physics researcher\(^5\) described the pressure many women feel to marry:

One thing in India is if you’re a girl you’re often expected to get married and settle down and have a family by your late 20s,

\(^5\)IND_59, male, physics, research scholar, interviewed May 27, 2014.
which is pretty much the time when you do your PhD and postdoc, and your career is at its high.

Several Indian scientists said that most women working in science face the conflicting pressures of pursuing an advanced degree and marrying. A biologist6 said,

India is a very patriarchal society, and women are not supported much by most families. So, most families see it like, “Oh you’ve already had a lot of education by the time you’re twenty, why do you want to get a master’s, why do you want to get a PhD? Why don’t you stay at home and look after the kids?”

Recognizing the authority of the family, she added that family responsibilities for Indian women include not only “looking after the kids” but also “taking care of parents as well as your in-laws.”

A professor in physics7 similarly said that the normative expectation that urges women to take care of the family “has come down from the generation before”:

There is still a feeling that if a housewife or a wife spends time away from home, something is wrong. . . . Whereas if I [a man] come back at midnight, there would be no question about it. If my wife comes back at midnight, my mother, brothers, and, yes, even I would wonder why.

The observation about women working late, made by both men and women, rests uneasily with the working norms of academic science. According to another respondent,8 this time a woman, science requires “some flexibility and a lot of time.” Indeed, for women in India, the compounding gender expectations are particularly salient for those who work in science.

More than 67 percent of our interview respondents in India believe that women assume more caretaking responsibilities than men. Among them, about 50 percent mentioned the role families play. For instance, one respondent said that the pressure on women to assume most of the family’s caretaking responsibilities is so intense that they “simply can’t beat it.” A graduate student9 said that if a husband asks his wife to “stop her research, then she should. There is no other option.” Although he added that one way for women to succeed in science is to find a spouse who “gives his wife support,” women face gender-based hurdles in science, even with supportive partners. A professor of biology10 said that her husband had been supportive, but after she made full professor, he wanted her to work less or not at all. She solved this by hiring someone she called a “maidservant,” who does most of the housework. Ironically, women working in science in India can do so only by hiring a woman from a lower social class to help with the housework and care for the family.

We observed that parenting in India plays a role in predicting the productivity of physicists and biologists. In our interviews, we found that the experiences of many respondents yielded clues to why the relationship between parenting and publication is gendered. In India, family plays two critical roles in influencing women’s publication productivity. First, many patriarchal gender norms are transmitted from families, and the strength of the gender norms is facilitated by family authority. Second, Indian women have extensive family responsibilities such as taking care of “the family, their in-laws, the house, and kids.”12 As a result, women working in science navigate between their family responsibilities and their careers, perhaps by finding supportive spouses, negotiating with them, or using their class status to seek help with family responsibilities from a woman of a lower class.

**Taiwan: Compounding Gendered Expectations and the Stigma of Singleness**

Like their colleagues in India, Taiwanese scientists reported that women are pressured to marry and have a family, a narrative summarized by the following research assistant in biology13: “Women, once they reach 35, have few marriage opportunities. We are not like the West. . . . For us, in Taiwan, the definition of marriage is to have babies.” She said that professional women must invest in time, and if women “put all their time” into their career, it probably means that “they cannot find a husband.”

Many Taiwanese respondents, regardless of gender, discipline, or rank, believed that the pressure on women to carry family responsibilities often comes from senior family members. A professor in physics14 said, “Especially in Taiwan or other Asian countries, the role of a woman in the family involves a lot of things such as child-raising and housekeeping.” Even if women “do not want to do it, their elders or other people may expect them to.” A woman in physics15 gave a similar narrative: “The older generation of female family members as well as male family members wonder why a girl would pursue a high-level education.”

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6IND_25, female, biology, scientist, interviewed May 21, 2014.  
7IND_42, male, physics, senior professor, interviewed May 24, 2014.  
8IND_15, female, physics, postdoctoral fellow, interviewed May 15, 2014.  
9IND_04, male, physics, assistant professor, interviewed March 14, 2014.  
10IND_27, male, biology, graduate student, interviewed May 21, 2014.  
11IND_34, female, biology, professor, interviewed May 22, 2014.  
12IND_22, female, physics, associate research scientist, interviewed March 31, 2015.  
13TW_17, female, biology, research assistant, interviewed November 10, 2014.  
14TW_21, male, physics, professor, interviewed November 11, 2014.  
15TW_32, female, physics, research assistant, interviewed November 27, 2014.
Given the pressure from families, several Taiwanese scientists said that women need to find strategies to be professionally productive and good mothers. One such strategy is to negotiate with senior family members for help. A physicist, for instance, said that once she has a child, she would “ask for help (from her family) with taking care of the kid temporarily.” We also interviewed a woman in biology, who, although she navigates between career productivity and family responsibilities by remaining single, feels the stigma of singleness. She recalled that, during an interview, “a committee member said, ‘This girl is already 35 and she’s still not married. She’s weird.’” Comments such as this led her to wonder whether her time would have been better spent “finding a boyfriend and getting married.”

Of the eight cases in our broader study, we found Taiwan and India to have similar gender ideologies. The cross-contextual similarity between India and Taiwan is also reflected in our interview data. The compounding gendered expectations, interwoven with the authority of family and pressure from senior family members, were reflected in our conversations with Taiwanese scientists. Still, despite this similarity, women’s responses to gender norms are somewhat distinctive in Taiwan, where they often raised the possibility of negotiating with extended families to distribute caretaking responsibilities. It is important to note, though, that women working in biology in Taiwan are disadvantaged in publishing in ways that cannot be explained by career and family-related variables. Although there is little evidence to explain why the marginal disadvantage of women’s publishing record holds for biology in Taiwan, the results of the present study led us to speculate that it may be due in part to institutionalized discrimination, such as the stigma of singleness.

The United States: Competing Devotions between Work and Family

In the United States, we often hear of the struggle between family and work. The narrative of one postdoctoral fellow in physics sums up the dilemma of a female scientist being “torn between spending time at work and spending time with her children.” However, he did not think that the dilemma is unique to science.

Yet a graduate student in physics believes that the expectation of work dedication is higher in science than other careers with similar education levels. She said, the institutions that perform [science] were built for dudes and were built on the assumption that all the people doing the science would be dudes who have stay-at-home wives that take care of the kids and house cleaning and stuff and so you get values like, “The more work, the better.” Unable to see herself facing, let alone overcoming, such obstacles, she chose to leave academia. “I have seen people go through the tenure process—fuck that shit!” she said. Such struggles are equally salient in biology. A graduate student in biology believed that “family expectations” make it more difficult for women to be successful scientists. Like the previous respondent, she thought of leaving a career in research, knowing that “there are people who can work harder, longer hours because they don’t have a family.” She does not “want to work 80 hours a week.”

Narratives describing women’s struggles with home and work consistently emerged. Respondents said, “If you’re a person who wants to be in the lab and doing science all the time, you can’t have a family,” and “If you give birth, that will prevent the progress of the research.” For these and similar reasons, some women leave academia altogether, lower their career expectations, or postpone having children if they have them at all.

Certainly, many women in the United States see the tension between family responsibilities and productivity as particularly acute in academic science, but they view it differently from women in Taiwan and India, where most recognize the influence of macro-level gender norms. In the United States the tension is often explained by a culture of hard work and commitment, which finds women torn between their scientific work and families. According to our survey, a significant relationship between work and family shows that U.S. scientists can raise their publication productivity only by spending less time with their family. This work-to-family strain is, for many, an unfortunate reality, leading some women to leave science permanently.

The United Kingdom: Child-Rearing, Maternal Leave, and Meritocracy

As in the United States, U.K. scientists are concerned about the tension between child-rearing responsibilities and science’s perceived meritocratic culture. One man who works as a lecturer in biology said, “I think it’s more difficult for women because of childcare.” Another noted that “You sometimes have to work late. You are experimenting; you

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16TW_12, female, physics, graduate student, interviewed November 6, 2014.
17TW_39, female, biology, assistant professor, interviewed December 26, 2014.
18We borrowed this term from Blair-Loy’s (2009) book title.
19US_20, male, physics, postdoctoral fellow, interviewed March 27, 2015.
20US_35, female, physics, graduate student, interviewed April 2, 2015.
21US_40, female, biology, graduate student, interviewed April 3, 2015.
22US_29, female, biology, professor, interviewed April 1, 2015.
23US_21, female, physics, graduate student, interviewed March 31, 2015.
24UK_12, male, biology, lecturer, interviewed December 3, 2013.
25UK_37, female, biology, professor, interviewed December 5, 2013.
can’t leave it,” an opinion shared by a colleague: “the work is very invasive” but she is “dedicated to it” because “science sucks you in, especially academic research, and there is no end to it.” Not surprisingly, such dedication can lead to marital pressures.

What differentiates the U.K. narratives from those in the United States is maternity leave. U.K. women can have maternity leave for up to 52 weeks (U.K. Government n.d.), but more than one fourth of our interview respondents—men and women—believe that maternity leave is not as helpful to women in academic science as it seems. A graduate student in physics felt that her work suffered with or without maternity leave: “Obviously if you take time off it’s going to impact your research at least in the short term.”

The negative influence of maternity leave on career growth is salient because grants, publications, and promotions all correlate. A professor said that the difficulty for women in science is “down to competitiveness and no allowance being made to the fact that women need time out to have children.” Maternity leave may even disadvantage women: “The fact that you missed out on a couple of years is a gap in your CV that makes you non-competitive for grants.” Thus, women may be inclined to shorten their maternity leave or come to the lab during it. A woman in physics took only “four and a half months” of maternity leave because “If I had taken a full year off, I would have lost out on a lot of grants; I wouldn’t have had the papers. . . . I feared that I would have been edged out.” Another, a biologist, said, “During my maternity leave, I was constantly in touch with everybody in the laboratory.”

Part of the reason why maternity leave in the United Kingdom makes it no easier for women working in science is that it fails to challenge family or workplace institutional norms. Respondents said, “You suffer for a year to eighteen months just coming back after having a kid,” and “I think a lot of it does come down to taking time out of your career. When you’re not publishing, then that does have a detrimental effect.” A colleague in physics added, “No one cares that you had only two papers published last year because you had kids, no one gives a shit.” Consequently, some women may not be “in the game after seven months of maternity leave.”

Although there are differences in research and scientific infrastructure development in the United States and the United Kingdom, respondents in both countries reflected on how competition in science increases the tension between family and work, felt especially by women. Surprisingly, our quantitative analysis shows that parenting is not significantly related to publication output in the United Kingdom. Perhaps this is because many women overcome, or try to overcome, the negative relationship between parenting and publishing by working during maternity leave and other phases of parenting.

**Discussion and Conclusion**

In this article, we examine how family responsibilities are related to publication and whether and how this relationship is gendered in India, Taiwan, the United States, and the United Kingdom. From our quantitative analysis, we found cross-national differences in which family responsibilities correlate with publication productivity. Specifically, the motherhood penalty on publication exists only among physicists in India and Taiwan. Marriage had a significant negative relationship to publishing for women relative to men in Taiwan and the United Kingdom. And in the United States, work-to-family tensions penalized women relative to men in physics but had a significant positive relationship with publishing in biology. Our interviews further show that the relationship between gender, motherhood, and publication productivity can be confounded by factors indirectly measured in our survey. Indeed, scientists across all contexts refer to family responsibilities as the most important factor preventing women from succeeding in science. Yet how family responsibilities influence women’s productivity differs according to country.

In India and Taiwan, many respondents attributed the negative influence of family responsibilities on women’s publication productivity to macro-level gender norms. According to our respondents, these norms impose an expectation on women to marry and have children early in their careers and discourage many from pursuing degrees or working in demanding professions. In the United States and the United Kingdom, our respondents focused more on the institutional arrangements in science, saying that these require competition, commitment, and long hours, leaving few spaces for female scientists to navigate between work and family.

Existing studies show how macro-level gender norms (Gupta and Sharma 2002; Ridgeway and Correll 2004) and institutional arrangements in the sciences (Gersick et al. 2000; Miller and Roksa 2020; Winslow and Davis 2016) work together to generate hurdles to women’s research

28UK_37, female, biology, professor, interviewed December 5, 2013.
29UK_94, male, biology, professor, interviewed December 5, 2013.
30UK_06, female, biology, lecturer, interviewed December 2, 2013.
31UK_77, female, physics, postdoctoral fellow, interviewed July 3, 2014.
32UK_54, female, physics, graduate student, interviewed March 6, 2014.
33UK_77, female, physics, postdoctoral fellow, interviewed July 3, 2014.
34UK_80, female, biology, senior lecturer, interviewed July 8, 2014.
productivity. Yet the existing studies do not reveal the specific mechanism that leads to a different reinforcement of gender inequalities in the research productivity of scientists in different societies. Our analysis illustrates that the cross-national differences in the relationship between family responsibilities and women’s publication productivity occur chiefly in two ways: (1) through context-specific macro-level gender norms imposed on women and (2) through how women navigate between their scientific careers and family responsibilities.

In India and Taiwan, macro-level gender norms generally embody the authority of men over women (Gupta 2017; Gupta and Sharma 2002; Wang and Stocker 2010). These norms interact with the authority of family in India and Taiwan, which translate into compounding gendered expectations that preclude women from succeeding as scientists. In the United States and the United Kingdom, macro-level gender norms are gender essentialist, portraying family care as a woman’s responsibility while not necessarily explicitly discouraging women from entering demanding disciplines or working hard (Ridgeway 2011). The different content and imposition of macro-level gender norms explain why interactions between family-related variables and gender are significant in India and Taiwan but less so in the United States and the United Kingdom. Such differences also explain why many Indian and Taiwanese respondents relied on macro-level gender norms to explain the disadvantages women experience in science, while US and UK respondents reflected more on science’s institutional arrangements.

In addition to context-specific gender norms, navigating between career and family may also differ for women scientists. On the basis of our respondents’ narratives in the United States and the United Kingdom, we wonder whether part of the reason why parenting, a central locus of family responsibilities, does not significantly disadvantage women’s publication productivity is that women self-regulate to a large degree, making personal choices to navigate between competing commitments by, for example, postponing family plans or not taking full maternity leave. Yet considering the authority of family in India (Gupta and Sharma 2002) and Taiwan (Yan 2011), such personal, agency-oriented strategies may not be feasible. There, women must use other strategies to navigate between family and science, by finding “an accommodating and supportive”35 spouse, hiring a woman in a lower social class to provide homecare,36 or finding what they describe as the necessary “energy and stamina”37 to stay in science. This may require the long-term sacrifice and stigma of remaining single. Regrettably, employing lower socioeconomic status care workers reinforces social inequalities in other ways, such as economic class, an injustice that calls for redress by a broader coalition of interests.

It is important to note that the aforementioned mechanisms are not exhaustive, nor do they explain the diverse reinforcement of gender inequalities in academic science. There may be additional mechanisms contributing to the contextual variations in family and productivity. Also, different disciplinary cultures in physics and biology may add complexities to the reinforcement of gender inequalities of those working in science. However, the differences across disciplines and even subdisciplines are beyond the nuances we can identify through our interview data, as almost all respondents talked about women’s experiences in sciences as a whole. We invite future scholars to build on this research.

This study has several limitations. First, there may be a selection bias embedded in our samples, because we studied only those who stayed in science. This selection effect may explain why we did not observe a direct relationship between gender and parenthood on productivity in the United States and the United Kingdom in our quantitative analysis. Yet the absence of a direct relationship does not rule out the possibility that women and mothers who stayed in research invested extra labor responding to the tensions between family responsibilities and their career, which is not measured in our survey. Second, our findings are based on four contexts and two disciplines and cannot be generalized to other sciences. Third, the authority of family in India and Taiwan is a context-specific theme that emerges in our interview data. Thus, we were unable to incorporate it into our survey instruments. Fourth, both the interviews and the surveys measure the respondents’ perceptions. Although these perceptions are highly correlated with the reality (Thomas and Thomas 1928), they do not necessarily and always correspond to the reality. Finally, although our interviews indicate more similarities than differences between the narratives of men and women about family responsibilities and women’s productivity, the scope of our data does not allow the study to conclude whether there are differences between men’s and women’s behavioral responses.

Despite these limitations, the present study analyzes novel data and makes three principal contributions to the literature. First, it provides a systematic comparison of family responsibilities and the publication productivity of physicists and biologists in four contexts. Second, it provides an empirical examination, using both survey and interview data, of how this relationship can be gendered across contexts. Third, it identifies two mechanisms that might contribute to the contextual variations in the gendered relationship between family responsibilities and the scientists’ productivity through (1) the imposition of macro-level gender norms and (2) the way women mitigate the tension between family and career. Although awaiting validation from future empirical studies, it is reasonable to suppose that similar mechanisms that construct the cross-contextual variations in the gendered relationship between family responsibilities and productivity may apply to other professions, such as law, health care, and technology.

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35IND_61, male, physics, assistant professor, interviewed May 28, 2014.
36IND_34, female, biology, professor, interviewed May 22, 2014.
37TW_43, female, biology, full professor, interviewed April 14, 2014.
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**Supplemental Material**

Supplemental material for this article is available online.

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