

A Gendered Approach to Science Ethics for US and UK Physicists

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Abstract Some research indicates that women professionals—when compared to men—may be more ethical in the workplace. Existing literature that discusses gender and ethics is confined to the for-profit business sector and primarily to a US context. In particular, there is little attention paid to gender and ethics in science professions in a global context. This represents a significant gap, as science is a rapidly growing and global professional sector, as well as one with ethically ambiguous areas. Adopting an international comparative perspective, this paper relies on 121 semi-structured interviews with US and UK academic physicists to examine how physicists perceive the impact of gender on science ethics. Findings indicate that some US and UK physicists believe that female scientists handle ethical issues within science in a feminine way whereas their male colleagues approach ethics in a masculine way. Some of these physicists further claim that these different approaches to science ethics lead to male and female scientists' different levels of competitiveness in academic physics. In both the US and the UK, there are “gender-blind” physicists, who do not think gender is related to professional ethics. Relying on physicists' nuanced descriptions this paper contributes to the current understanding of gender and science and engineering ethics.

Keywords Science ethics · Gender · Academic physics · Workplace

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Introduction

The emergence of fraud in science draws attention to a pernicious problem: too often, experimental results can't be reproduced or data breaches are suspected (Achenbach 2015). Editors of top scientific journals presume the need to go back to basics, saying, "We need to train our students over what is okay and what is not okay, and not assume that they know" (Achenbach 2015). To provide scientists with better ethics training, we need a more thorough understanding of science ethics. Researchers who study the professions more broadly have suggested there may be gender differences in approach to ethics (Adam 2000; Anderson et al. 2013). Gender is, however, neglected in previous studies of science ethics.

Specifically, in for-profit occupations, such as finance, accounting, and business, scholars find that, compared with their men colleagues, women are less likely to engage in unethical behavior—such as using shortcuts for estimating a method or inappropriately claiming an extra travel expense—and are less tolerant of professional misconduct (Adam 2000; Anderson et al. 2013; Betz et al. 1989; Davis 2013; Fox and Braxton 1994). Expanding on previous scholarship on gender and ethics, we investigate the relationship between gender and science ethics in academic physics—a discipline that has a particularly low proportion of women (Ecklund and Lincoln, 2016)—through listening to physicists' own voices.

An examination of gender and science ethics is important, especially considering the lack of women in disciplines like physics (Blickenstaff 2005; Etzkowiz et al. 2000) and the masculine disciplinary culture in most, if not all, scientific disciplines (Ecklund et al. 2012; Cech et al. 2011). Specifically, an interrogation of gender and ethics from physicists' own perspectives may show how the gender and ethics relationship is framed by the gender stratified structure and masculine disciplinary culture of physicists. With science ethics as a lens, this study also has implications for the mechanisms that may subordinate women in other male-dominated areas of science.

We draw on physicists' narratives in the US and UK as an initial step to understanding the relationship between gender and science ethics. Descriptively, we ask whether US and UK physicists identify any gender differences in scientists' approaches to science ethics. Adopting a comparative perspective, we investigate whether and to what extent they have different understandings of gender and ethics. Interpretively, we analyze how physicists' own understandings of the relationship between gender and ethics are related to perceptions of masculinity and femininity in the physics community.

Both men and women physicists that we spoke with frame male physicists as having a masculine way of approaching science ethics, characterized by assertively engaging in scientific competition. In contrast, female physicists, they argue, adopt a more feminine science ethics approach, characterized by being more cautious with data and conclusions drawn from data. Some of these physicists further indicate that male and female scientists' differing approaches to professional ethics actually influence their scientific productivity. In both the US and the UK, there are "gender-blind" physicists who perceive no differences in ethical practices, but are also blind

to gender stratification in physics more broadly. Our UK and US respondents, however, differ in the type of gender-blind ideology they adopt.

Conceptualization of Scientific Ethics

Scholars conduct extensive research to investigate why some professionals behave unethically, and, more importantly, how to detect and eventually curb unethical behaviors (e.g. Abbott 1983; Anderson et al. 1994, 2013; Braxton and Bayer 1996; Chung 2015; Davis 2013; Davis et al. 2007; Scholossberger 2015). In these studies, professional ethics is a dual-dimensional concept, including both an occupational and an individual level of analysis (Abbott 1983). At an occupational-level of analysis, professional ethics refers to a “profession’s corporate obligations for service to the society” (Abbott 1983, pp. 855). And at an individual level of analysis, professional ethics are individuals’ adherence to formal and informal rules that serve as normative control within the professional role (Abbott 1983). These two levels of analysis interact with each other—individuals’ unethical behaviors in every occupation carry undesirable consequences on the occupational level, such as shaking public confidence in a specific corporation and further decreasing the authority and legitimacy of the knowledge and products a particular sector generates (Anderson et al. 2013; Betz et al. 1989; Hackett 1994; Kelly and Chang 2007).

Even though previous studies frame professional ethics on two levels of analysis, the current scholarship on science ethics largely confines itself to an individual-level of analysis—the formal and informal rules that regulate individual professionals’ behaviors (Abbott 1983). This potentially problematic focus on individual-level ethics can be found in scholarly discussion and governmental definition. For example, Anderson et al. (1994) classify unethical behaviors in science according to research misconduct, employment misconduct, and personal misconduct. This typology embraces science ethics in different domains. With a specific focus on the domain of scientific research, the US Office of Research Integrity defines research misconduct as fabrication, falsification, and plagiarism (The Office of Research Integrity, N.d.).

While there are clearly framed typologies of science ethics in both scholarly discussions and governmental definitions, there is another more implicit yet overarching norm that closely relates to scientists’ conceptualization of science ethics—competition (Anderson et al. 2007). The scientific community values competition (Anderson et al. 2007; Merton 1973). Scientists compete with each other to obtain resources, such as prestige, funding, students, and influence that enable them to survive in the scientific community (Anderson et al. 2007). The severe competition in science contributes to scientists’ ethically gray conduct, such as the temptation to pressure students or do scientific research and publish results too quickly, all in an effort to help scientists get ahead of the competition (Anderson et al. 2007; Johnson and Ecklund 2015). Being competitive and assertive are characteristics largely regarded as masculine (Cech et al. 2011; Ecklund et al. 2012), meaning that the value of competition in the sciences may give rise to a perceived masculine disciplinary culture.

What we see from existing literature is that science ethics is ambiguous. In this article, we use “science ethics” to refer to professional ethics in the scientific community. Science ethics embraces but is not limited to research ethics. Given ambiguities in the definition of ethics, we allowed participants in our study to raise their own conceptualization of ethics.

Gender and Ethics

Two prevalent theories are used to explain why female professionals may be more ethical than their male counterparts: the socialization approach and the structural approach (Betz et al. 1989). According to the socialization approach, men and women are socialized differently long before they enter the workplace. This means that men and women bring different gender characteristics into the workplace, with men emphasizing achievement and women focusing on harmonious relationships (Betz et al. 1989; Gilligan 1982). Proponents of the structural approach also acknowledge that there may be different socialization patterns between men and women. People who support the structural approach argue that the importance of occupational training outweighs the importance of gender socialization in the workplace (Betz et al. 1989). Given this assumption, the structural approach presumes that male and female professionals have received the same occupational socialization when they enter the workplace (Betz et al. 1989). Men and women, therefore, have similar ethical orientations and behaviors in professional settings (Betz et al. 1989). Empirical research that examines individuals’ ethical values in business largely supports socialization approaches, given the evidence that, under certain conditions, men and women seem to make different and gender-patterned ethical decisions (Ameen et al. 1996; Betz et al. 1989). Here we invite physicists in the US and UK to frame the connection between gender and ethics based on their own experiences and observations in academic physics.

Gender and Science

Examining general gender stratification in science provides us with a backdrop to understand why scientists may think there is a particularly gendered approach to science ethics. Men are overrepresented in science, technology, engineering, and mathematics (STEM) (Blau et al. 2006; Charles and Bradley 2009; England 2010; Grusky and Charles 2000; Miller et al. 2014; Reuben et al. 2014). And physics is among the most gender imbalanced disciplines (Ecklund et al. 2012), making it a window through which we can observe the connection between gender and ethics in a highly masculine discipline.

In highly masculinized disciplines, gender stratification may come from the notion of traditional gender roles (Ceci and Williams 2011; Parsons and Bales 1955), pre-college factors that direct women away from math-intensive fields (Ceci et al. 2014), and the symbolic power of the ideal scientist being made synonymous with masculine characteristics (Acker 1990; Cech and Blair-Loy 2014; Cech et al.

2011; Ecklund et al. 2012; Fox 2005). For instance, constrained by the assumption that women carry more responsibilities in childrearing (Parsons and Bales 1955), female scientists experience the challenges of time management, unfavorable evaluations as a result of how others perceive their commitment to parenting, and limits to their mobility because of their husbands' careers (De Cheveigner 2009). The popular notion of the "ideal scientist"—usually a man with forceful characteristics who centers his life on science—further marginalizes women in science (Acker 1990; Cech and Blair-Loy 2014; Cech et al. 2011; Ecklund et al. 2012; Ecklund and Lincoln 2016; Fox 2005). We expect that the gendered stratified structure and masculine occupational culture in academic physics may frame physicists' perceptions of science ethics.

Masculine and Feminine Ethical Approach in Science

In our analysis, gender contains cultural meanings. As an important social institution, gender constrains people's behaviors by classifying them into categories, labeling them, and compelling them to act according to normative expectations (Douglas 1986; Schilt 2011). For example, hegemonic masculinity requires men to be powerful, assertive, and goal-oriented (Belenky et al. 1986; Connell [1995] 2005) whereas hegemonic femininity instructs women to be caregiving and meek (Belenky et al. 1986; Connell [1995] 2005).

Based on the assumption that gender may be associated with how professionals view ethics, this article analyzes whether physicists perceive men and women as having differing approaches to science ethics as well as how the normative expectations of their gender identity might frame such approaches. Assuming that ethics are the locus of the interplay between gender and professional identity, we further investigate how such interplay influences female scientists' upward mobility in such a highly masculine profession.

Gaps in the Literature

Though previous studies paint a richly detailed picture about the relationship between gender and ethics, significant gaps in the literature remain (e.g. Adam. 2000; Ameen et al. 1996; Betz et al. 1989; Dalton and Ortegren 2011). This paper expands on previous literature by examining gender and science ethics in academic physics. Filling this gap in the literature is particularly essential considering the stratified gendered structure and masculine disciplinary culture in physics (Blickenstaff 2005; Cech et al. 2011; Etkowiz et al. 2000). We expect that this gendered structure and disciplinary culture may contribute to physicists' own interpretation of gender and science ethics.

To develop a more comprehensive understanding, we adopt a comparative perspective, analyzing how physicists in the US and UK perceive the relationship between gender and science ethics in academic physics. The US and the UK make a good comparative case since they are both industrialized countries where gender

segregation issues are salient (Blackburn et al. 2002), yet these two nations differ in terms of their scientific infrastructure and gender distribution in science. Within academia in the US, overt gender discrimination does not adequately explain the prevalence of men in the academic community (Probert 2005), yet the culture of individualism has become a more dominant explanatory factor for gender segregation in US STEM (Cech 2013). In the UK, women in the academy do experience overt gender discrimination (Knights and Richards 2003). Female British academics are more likely to be hired on short-term contracts and receive less pay than their male colleagues (Knights and Richards 2003). Through the comparison of physicists' narratives in the US and the UK, we investigate how and to what extent scientists' understandings of gender and ethics are both similar and different in two Western industrialized contexts.

Data and Methods

Data for this analysis come from a broader study—Ethics among Scientists in International Contexts (EASIC)—that consists of in-depth interviews with physicists in both elite and non-elite universities in the US, UK, and Mainland China. The objective of the broader study is to understand how physicists in three national contexts approach important ethical issues facing science. For this article, we utilize the narratives just from physicists in the US and UK, where we asked questions about the impact of gender on approaches to science ethics (we were not able to ask this question in China).¹

Sample selection in the UK started from an identification of elite and non-elite universities. We triangulated three criteria to differentiate elite universities from non-elite universities: research productivity according to published research articles in the Web of Science, published rankings, such as 2008 UK Research Assessment Exercise, and input from scientists in UK universities. Based on geographic locations and practical concerns, four elite universities and three non-elite universities were selected into our samples. The selection of seven UK universities—both elite and non-elite—yielded a sampling frame of 289 physicists. Afterwards, we drew a stratified random sample that ensured the representation of female physicists and a balanced proportion of physicists in different career stages. Our final sample contains 132 potential respondents, and 71 of them participated in our interviews.² After conducting these 71 interviews, we found an overrepresentation of voices from scientists located in elite universities. We then conducted 10 interviews with supplementary respondents from ten additional non-elite universities.

Similarly, in the US, we rely on the National Research Council (NRC) rankings to identify elite universities and non-elite universities. Taking geographic diversity,

¹ This study has received the approval from our university's Institutional Review Board (IRB).

² Completing 71 interviews with 132 potential respondents in our main sample led to a response rate of 53.8 %. It is important to note, however, that this is the most conservative calculation. We also have 32 potential participants who agreed to conduct an interview with us but were unable to schedule an interview due to schedule conflicts and other kinds of practical difficulties.

department size, private/public distinctions, and practical concerns into consideration, we selected four elite universities and five non-elite universities. The selection of nine universities in the US led to a sampling frame of 340 physicists—with 242 in elite departments and 98 in non-elite departments. When we drew a stratified random sample from the sampling frame in the US, we prioritized gender and intended to have a balanced representation from physicists in both elite and non-elite departments. Eventually, 179 physicists were selected in our sample, and we successfully scheduled and conducted interviews with 90 of them.³

Overall, a total of 171 interviews were completed with 90 physicists in the US and 81 physicists in the UK. The interviews took between 35 min and 2 h and 15 min. Seventy-eight interviews were conducted in person, and 93 interviews were conducted by phone or Skype. We did not ask questions related to gender in all interviews because some respondents wanted an abbreviated version of the interview guide. In that case, we allow the interviewers to use a shortened interview guide and skip the questions about gender. Given the lack of gender content in some of the interviews, we rely on 121 interviews where respondents connect gender and ethics.

Fifty-five of the 121 interviews with gender content were conducted with US scientists, while the remaining 66 were conducted with UK scientists. For this article, we focused analysis primarily on the following interview question: “Our research has a particular interest in gender and physics. In relationship to this particular topic of science ethics, to what extent—if any—do you think men and women experience issues of ethics or responsibility in science differently?”⁴ We paid particular attention to themes generated by past literature—whether or not physicists think female professionals are more ethical than male professionals. At the same time, we also adopted an inductive approach, focusing on themes that consistently appeared among physicists’ narratives but have not been systematically investigated in previous literature.

This research does not aim to capture the narratives from all physicists in the US and UK. Rather, our intention is to understand how some physicists in the US and UK perceive gender and ethics. Physicists’ perceptions are important, as they may influence their reinforcement and transformation of the gendered structure and institutionalized culture in academic physics (Thomas and Thomas 1928). As science professionals and in many cases academic science leaders, these physicists are not only constrained by overarching gender norms in the scientific community, they also have certain degrees of agency to either transform or reproduce the cultural norm. Their narratives thus provide us with an initial picture of gender and ethics in science.

³ Conducting 90 interviews among 179 potential respondents yielded a response rate of 50.28 %. But, again, this is a very conservative calculation given that we were unable to schedule interviews with some of the respondents; 15 participants in addition to the 90 who completed the interviews, were not scheduled due to practical difficulties.

⁴ Different from questions in survey-based quantitative studies (Cresswell 1997; Rubin and Rubin 2011; Strauss and Corbin 1998), in this question, we are not seeking yes or no answers. We are interested in respondents’ in-depth and nuanced narratives.

Findings

The interviews with US and UK physicists illustrate that our participants display different levels of awareness of the gender-ethics relationship. Some of our respondents in both nations realize that male and female physicists have different approaches to science ethics. They claim that female scientists are usually more ethical than their male colleagues. Some of these physicists further posit that this feminine approach to scientific ethics reduces the competitiveness of female scientists because women waste too much time checking their data and are not assertive enough to assure they get credit for their work.

In contrast, other respondents in both the US and UK claim that male and female scientists approach science ethics in the same way. The way they frame the relationship between gender and ethics, however, differs across national context. Adopting an individualistic explanation, these US physicists believe that men and women are working in equally tough professional circumstances. They contend that the career trajectories of scientists depend upon their personal efforts, and they neglect any structural elements that challenge female scientists. We label this “gender-blind” ideology “abstract liberalism.”⁵ Unlike their colleagues in the US, so-called UK “gender-blind physicists” in our sample express their lack of awareness about gender and ethics in a more extreme way. A majority of these UK physicists claim that gender, as an identity, is not socially meaningful in the scientific community. We label the gender-blind ideology adopted by UK physicists “minimization of gender differences.”

Individual-Level Ethics: Women are More Ethical

Among our US and the UK physicists, twenty-seven mentioned gender differences in approach to ethics. All of these conceptualize science ethics as an individual-level phenomenon, believing that females better internalize ethical norms and are thus more ethical scientists than their male colleagues. Such an approach was often framed as a matter of competition.

For example, our conversation with a female associate professor⁶ at an elite US university illustrates this perspective. When commenting on whether male and female scientists have different ethical behaviors, she said:

Yeah. I think that, again, there are curves in this...that there's this kind of spectrum of people who are ... super responsible, maybe err on the side of not even getting anything done, versus the people who want to win at all costs. If you look at that spectrum, there's probably a male curve and a female curve. And I admit that the sample size that I have of women is really, really small, so I don't actually know for sure. But I would say that the small number of women, whom I am close to, are closer to the end of the spectrum- the kind of very responsible end of the spectrum.

⁵ We borrow this particular label of “gender-blind ideology”—abstract liberalism and gender minimization—from Bonilla-Silva's (2006) argument about “color-blind racism.”

⁶ US_08, female, associate professor, elite university, conducted 03/25/2013.

This US female physicist conceptualizes approaches to science ethics as being along a spectrum. According to this respondent, female physicists' science ethics is situated at the end of "not getting anything done" while her male colleagues' approach to science ethics is situated at the end of "winning at all costs." Articulating female physicists' ethical approach as "on the side of not even getting anything done," because of an over-focus on whether they are ethical, this respondent further implies that female physicists face the consequence of being less engaged in scientific competition than their male colleagues who want to "win at all costs."

In the UK, a male physics professor⁷ at an elite university also claimed that female physicists are usually more ethical:

I have seen evidence that women are probably more responsible, less prone to assert things that they don't absolutely know are true and therefore sort of can have a sort of better sense of responsibility and worry about things, you know, how things might go wrong and how they would cope with them if they did, and therefore *not* sort of, just pushing on regardless.

Similar to the US associate professor, this UK professor states that his female colleagues have higher individual-level professional ethical standards than male physicists. He seems to be indicating that female physicists handle scientific ethics in a more feminine way in that they "worry about things" and are "less prone to assert things."

Confirming the findings from past literature (e.g. Ameen et al. 1996; Betz et al. 1989), our respondents' narratives demonstrate that some physicists in our study believe female scientists are generally more ethical than their male colleagues. Yet, beyond this previous research our interview data also illustrate that physicists have similarly gendered understandings of how male and female physicists approach work and ethics. In both the US and UK, physicists we spoke with described female scientists as "... more careful and more willing to say 'oh, I am not very sure about this'"⁸ and as "tak[ing] more responsibility for what they are doing,"⁹ whereas male scientists are "very bold about their statements"¹⁰ and "have a tendency to rely on somebody picking up the dirt behind them [rather than] dealing with the problems they have."¹¹

Interestingly, in their answers to the question about gender and ethics, most of the physicists who perceive female physicists as being more ethical than their male colleagues relate science ethics to people's engagement in competition. Based on their conceptualization of science ethics, these physicists explained that male physicists are less ethical than their female counterparts, given that male physicists are more engaged in scientific competition. Specifically, our respondents described

⁷ UK_09, male, professor, elite university, conducted 09/19/2013.

⁸ US_17, female, non-elite university, assistant professor, conducted 04/03/2013.

⁹ UK_42, male, reader, elite university, conducted 02/26/2013.

¹⁰ US_17, female, assistant professor, non-elite university, conducted 04/03/2013.

¹¹ UK_42, male, reader, elite university, conducted 02/26/2013.

the ethical approach of male physicists as being “bold about their statement,” “push(ing) on regardless,” and “win(ning) at all cost.”

As we know from other research, being assertive and competitive are important characteristics of hegemonic masculinity (Connell and Messerschmidt 2005; Light and Kirk 2000), characteristics that reinforce male domination (Connell and Messerschmidt 2005). These narratives from our respondents provide some evidence that the normative expectations of each gender category have been transposed to ethical approaches in the academic physics community in both the US and UK

Feminine Ethics Disadvantages Women’s Competitiveness in Physics

That our physicist respondents perceive women to have a higher level of individual ethical standards, however, does not necessarily position women in an advantaged place. Among the 27 US and UK participants who acknowledge the connection between gender and ethics in academic physics, around one-third of them (8 participants) informed us that women’s feminine ethical approaches actually disadvantage female physicists. A female associate professor¹² at an elite university in the US, for instance, talks about how physicists relate female scientists’ ethical approaches to their productivity. She explained:

I think the women probably are less prolific than men, and maybe that could be blamed on, “Oh, women don’t have as many hours to work because they are spending time with their kids.” And that might not be the answer. It might be because of this issue of wanting to really be sure it’s correct and doing careful detailed checks of everything.

This associate professor does not think that women scientists’ commitment to childcare leads to perceived lower productivity, as scientists often believe. Instead, she attributed women’s perceived low productivity in physics to their ethical approach, implying that female physicists’ spend too much time checking their data as a result of their lack of confidence. Such a practice makes these women more ethical but “less prolific than men.”

Similarly, another US female associate professor¹³ at an elite university suggested that women’s ethical practices make them less competent in the scientific community. When the interviewer asked her whether there are any gender differences regarding scientists’ approach to ethics, this female scientist reflected on her own experience, saying:

When I was younger, honestly, the fact that there was a woman, and there were so few of them...I’m more sensitive, I think, to bias or to comments that people make. ... when I was younger, I wasted time checking things many times more than I should have before I presented my case, so to speak.

¹² US_08, female, associate professor, elite university, conducted 03/25/2013.

¹³ US_21, male, associate professor, elite university, conducted 04/15/2013.

Although at the end of her narrative, this female physicist claimed that she does not think in gendered terms, she provided this information in response to the question about gender and ethics, meaning that she still thinks her approach to science ethics—a careful check of her findings—is somewhat related to her identity as a *female* physicist. Similar to the previous respondent who told us that female physicists' detailed checking can make them less prolific than male physicists, this associate professor also stated that she—as a representative of female physicists more broadly—“wasted time checking things many times more than I should have.” Using the phrase “wasting time,” this female associate professor claimed that her ethical approach was not just careful but “overly” careful.

Similar to their counterparts in the US, some UK physicists also connect female physicists' ethical approaches to their presumably disadvantaged position in the physics community. Slightly different from their US colleagues, who attributed female physicists' comparatively perceived low productivity to the time spent on data checks, four UK physicists we interviewed said female scientists are less likely to take credit, leading to disadvantage in academic physics—a community that seems to value competition. Thinking about his female colleagues, a male UK lecturer,¹⁴ who works at an elite university, contended that female physicists should adopt masculine ethical approaches to be successful:

I find that ... particularly the women who succeed in my field are the ones who are most male-like in some sense and promote themselves very strongly and sort of borderline take credit for anything they can, and I see that perhaps this inequality forces people to do things that they wouldn't be so comfortable doing, or they are uncomfortable doing because they think, “okay, I am compromised.”

The observation of this male UK physicist provides important pieces of information. First, he notes that successful female physicists are “most male like,” which means that these female physicists adopt the masculine ethical approach by “promot(ing) themselves very strongly and sort of borderline tak(ing) credit for anything they can.” From an opposite perspective, according to this respondent, female physicists should abandon their feminine ethical approach and do something that they are not “so comfortable doing” to achieve success in physics. And the narrative from this UK participant also reveal that the lack of women and the masculine disciplinary culture in physics perhaps explain why women need to be ethically “male like” in order to be successful.

Another male UK lecturer¹⁵ at a non-elite university made a similar comment that in broader society, men are more likely than women to seek social success. According to this lecturer, female scientists in the UK do not necessarily deal with science ethics in a way that is different from their male colleagues because the sample of women who choose a career in physics is less feminine than non-scientist women. That is to say, according to this lecturer, the reason why some women

¹⁴ UK_14, male, lecturer, elite university, conducted 09/30/2013.

¹⁵ UK_76, male, lecturer, non-elite university, conducted 05/20/2014.

successfully enter and eventually remain in physics is because these women adopt a masculine instead of feminine ethical approach.

Outside academic physics, men and women are societally socialized in different ways (Schilt 2011; West and Zimmerman 1987). As a consequence, men are socialized to practice characteristics, such as being assertive and competitive, which then are made synonymous with being “male” (Connell and Messerschmidt 2005; Light and Kirk 2000). Females’ embodiment of masculinity is often sanctioned by broader society (Schippers 2007). But within academic physics, our US and UK physicists seem to indicate that the expectation of science ethics is gendered and—to some extent—women are expected to “act like men” in order to succeed. Specifically, the normative gender expectations in the broader society are joined to the masculine disciplinary culture in physics. According to them, women who adopt a feminine approach are “wasting time”¹⁶ and “thus less prolific”¹⁷ than men. These physicists further told us that if women want to be successful in science, they should adopt a masculine ethical approach, behaving in more competitive and assertive ways. The group of these physicists who link women’s ethical orientation to their disadvantage in academic physics is not large in our sample. But their narratives provide us with the possibility that a gendered ethical approach may be a double-edged sword for women in academic physics.

Occupational-Level Ethics: Gender Discrimination in Academic Physics

Most of the literature about science ethics defines ethics at an individual-level of analysis, examining individuals’ adherence to ethical norms (e.g. Anderson et al. 1994; Davis et al. 2007; Fang et al. 2013). Our conversations with the US and the UK physicists about gender and ethics, however, disclose that a fairly large number (42 participants) of these physicists conceptualize scientific ethics on an occupational-level of analysis. These physicists perceive gender discrimination as an important ethical problem in the scientific community as a whole. A male US assistant professor,¹⁸ for instance, realizes that as a minority group in physics, female physicists experience bias:

There is a big imbalance of female versus male physicists and I would be extremely upset to see a guy using this to dismiss an argument of a girl. I mean this is another example for which I think you have been very irresponsible and not ethical regarding scientific research is to use personal things [like gender] to ... pass an idea over some others.

As an “insider” in the academic community, the first thing about gender and ethics that occurred to him is gender discrimination as an occupational-level unethical behavior in the scientific community. To him, science ethics is not only about whether individual scientists behave ethically but also about the extent to which physics—as an occupational community—act in an unethical way. By and large, his

¹⁶ US_21, female, associate professor, elite university, conducted 04/15/2013.

¹⁷ US_08, female, associate professor, elite university, conducted 03/25/2013.

¹⁸ US_06, male, assistant professor, non-elite university, conducted 03/22/2013.

response to the question about gender and ethics displays the salience of gender discrimination in academic physics.

Some of the UK physicists that we spoke with also perceive gender discrimination as an important ethical problem in the UK physics community. A female senior lecturer¹⁹ in the UK expressed strong opinions about gender bias within the scientific community. She articulated:

And so, I will think that yes, until we are convinced that women scientists and men scientists are treated the same by either the system or their colleagues, then we could say that from the ethical point of view that they would be the same. But I think at the moment it is probably true that in general men and women in science are being treated differently by their colleagues, their community, and the system in place.

As a female physicist, on the one hand, this senior lecturer envisions that the standard of science ethics will reach a point where male and female scientists are treated equally. On the other hand, she realizes that at least at this time, gender bias still exists in the scientific community.

“Gender-Blind” Physicists: Gender is not Related to Ethics

Despite the fact that a number of UK and US physicists we spoke with realize that there are differences in how male and female scientists approach science ethics, fifty-two physicists in our sample do not think a scientist’s gender identity is related to how he or she handles ethical issues that face physics. We label these respondents “gender-blind physicists.” The narrative of a male US associate professor²⁰ at a non-elite university illustrates how gender-blind scientists downplay the role of gender in the scientific community. He explained:

I think it’s all about your personal—it’s who you’ve been in contact with, examples you’ve seen, starting with your parents and going on through your colleagues. It’s like the kindergarten teacher—the great kindergarten teachers know who plays with who. And that’s very important. They know that that’s what matters. So I don’t—boy, I wouldn’t be able to draw any distinction. But I think that ... it’s very much a personal thing.

This associate professor adopts an individualistic explanation to understand gender and science ethics. He believes there are no categorical differences in how men and women deal with science ethics. Instead, “it’s very much a personal thing.” Attributing scientists’ work ethics to personal choices, this scientist did not allude to any structural differences for men and women in science, let alone whether these differences exert an influence on scientists’ approaches to work ethics.

A male professor²¹ at an elite university in the US expressed similar opinions, saying, “I think everyone suffers equally.” Interestingly, later in the interview he

¹⁹ UK_73, female, 40 years old, senior lecturer, non-elite university, conducted 05/10/2014.

²⁰ US_13, male, associate professor, non-elite university, conducted 03/26/2013.

²¹ US_79, male, professor, elite university, conducted 11/06/2013.

claimed, “We’ve been struggling as a discipline to identify why we suffer this gender imbalance.” Recognizing the gender imbalance in the physics community, he was still unaware of “individual instances where gender has played a particular [role] or where I can distinguish a gender specific component.”

Adopting individualistic explanations, most US scientists think that divergent approaches to science ethics should be attributed to individual differences rather than gender. Ignoring the highly masculine culture within the academic physics community and holding the impression that everyone is working under the same circumstances in the larger physics community, these gender-blind American physicists are more inclined to blame female scientists who raise concerns about gender discrimination as being overly sensitive to gender issues. One US physicist²² we spoke with used a specific example to illustrate that women tend to interpret everything in a gendered way. He said:

You get a position like, that the university backs you, right? ... we had an adjunct faculty, she’s – and I will say, the people I had trouble with were all women. OK? ...we had a new assistant professorship in astronomy, and she was maybe 45 or so and teaching a while, and she applied for the job, OK? And so we – of course, the committee is totally confidential and we came up with a list of five finalists that we were going to invite to [interview]. And we didn’t include her. So somehow she gets the list of our five candidates, and decides that she’s better than all five of them, and that, because we didn’t pick her, we must be discriminating against her.

When we asked this scientist about his understanding of gender and ethics, what first came to mind for him was his impression that female physicists are overly sensitive about gender discrimination. He could not understand the reason for this, unable to identify any structural differences between female and male physicists’ working environments.

There are also “gender-blind physicists” in the UK who do not acknowledge gender differences in science ethics. Yet, utilizing a different gender-blind ideology from their US counterparts, “gender-blind” physicists in the UK minimize the role of gender, explaining that gender identity is not socially meaningful in any professional environment. For instance, an academic fellow²³ at an elite university in the UK said:

I only know a handful of women in my field, you know well enough to have discussions about this sort of thing. I don’t know, so on a day to day working basis when I’m working with them I don’t really recognize that they’re female even, so I have these moments where if we go to a social event or something, and I suddenly see them dressed up in makeup that sort of wakes me up to the fact they are of a different gender.

For this physicist, gender status is not socially meaningful in professional circumstances. Only in casual and social situations does he notice that some of his

²² US_11, male, non-elite university, conducted 03/26/2013.

²³ UK_62, male, academic fellow, non-elite university, conducted 04/04/2014.

colleagues are women. Moreover, the realization of his colleagues' gender identity is predicated upon visible feminine symbols, such as dress and makeup. According to his observations, female physicists in professional environments rarely use perceivable feminine symbols to perform their gender identity.

This academic fellow is not the only UK respondent in our sample who thinks gender differences do not exist in professional environments. Another professor²⁴ at a non-elite university in the UK told us that, to him, difference in gender is about the same as difference in hair color. Neither of them are socially meaningful in professional situations. This professor said:

I mean apart from them being women, which is obvious. But it's not more obvious than someone with red hair, I wouldn't say of course, human nature varies, and women have certain traits that are different from men, but apart from that I haven't really noticed any ethics bias in anything.

"Gender-blind" physicists in both the US and UK do not think ethics is a locus that reflects the interplay between gender and ethics. When these physicists deny the differences in males' and females' approaches to science ethics, they are denying structural differences for male and female scientists.

Discussion and Conclusion

We have illustrated that existing research in science ethics empirically overlooks the connection between gender and ethics in science and conceptually underemphasizes occupational-level ethics in science. Relying on interviews with 121 physicists in the US and the UK, our analysis reveals that US and UK respondents' articulation of gender and ethics clusters into three categories. The first group (27 respondents) mentioned the connection between gender and individual-level science ethics, claiming that men and women have different ways of handling ethics in academic physics, and female physicists are generally more ethical than their male colleagues. Surprisingly, one-third of these physicists also informed us that this feminized ethical approach may disadvantage female physicists' research productivity. The second group of our respondents (42 participants) connected gender with occupational-level ethics in academic physics. They perceived gender discrimination itself as an important ethical problem in the academic physics community as a whole. Finally, a large group of our respondents (52 participants) do not see any connection between gender and ethics in science. These "gender blind" physicists also deny gender stratification in the scientific community.

The three categories of these US and UK physicists' narratives also show how framing what it means to be an ethical scientist becomes a mechanism that disadvantages female physicists. For those physicists who talk about gender and individual-level scientific ethics, their conceptualization is based on the extent to which individual scientists engage in competitive behavior. According to these physicists, men are less ethical than their women colleagues because they are more

²⁴ UK_70, male, professor, non-elite university, conducted 04/30/2014.

assertive in the competitive aspects of science. Science values competition (Merton 1973). As a consequence, ironically, women's less assertive style of scientific competition makes them more ethical but at the same time disadvantages women in academic physics. Our participants in both national contexts further inform us that if female physicists want to be successful in academic physics, they need to abandon their feminine ethical approach and adopt a masculine ethical manner. That is to say, within academic physics, individual-level ethical norms are gendered, and, according to our respondents, the norms that benefit individual physicists are masculine.²⁵

In addition to these physicists who talked about gender and individual-level science ethics, the second group of our US and UK participants talk about the connection between gender and occupational-level science ethics, pointing out the salience of gender discrimination in science. Considering the prevalence of gender discrimination in science, we speculate that female scientists' experiences of gender discrimination contribute to their being extra cautious when handling data and applying an ethical framework to collecting and analyzing data, for example by checking results multiple times before making assertions. Gender discrimination—as an important ethical problem in the academic physics community as a whole—is the second mechanism that disadvantages female physicists. This mechanism may intersect with the first mechanism by pushing female physicists to utilize a feminine ethical approach—being more careful and less assertive.

In our interviews with physicists in the US and the UK, we encountered “gender-blind” physicists who do not see any relationship between gender and ethics. These gender-blind physicists in the US and UK adopt different gender-blind ideologies. Physicists in the US tend to utilize a gender-ideology of abstract liberalism and neglect the gendered structure in science. In contrast, UK physicists utilize a gender-blind ideology of gender minimization, asserting that in academic physics gender identity is not socially meaningful. The different gender-blind ideologies according to national context imply that US and UK physicists may be socialized about gender relations in different ways, but both types of gender-blind ideologies allow these physicists to neglect gender stratification in academic physics as a salient issue. As a result, these typically male physicists subconsciously enjoy the privilege their gender status brings, exerting indirect discrimination²⁶ towards their female counterparts, and consistently reinforcing the gender-stratified structure of science. These two types of gender-blind ideologies and their specific application to science ethics act as the third mechanism that subordinates female physicists.

Here, adopting a comparative perspective, we find that, despite the different construction of scientific infrastructure and the salience of gender discrimination in the US and the UK (e.g. Cech 2013; Knights and Richards 2003; Probert 2005), the American and British physicists we spoke with in many ways share similar

²⁵ Our data is based on the perception from our participants. It may have implications for but does not necessarily indicate the actual productivity of female physicists. Other studies, such as Long (1992), assert that although female scientists may publish less, on average, papers that are produced by female scientists receive more citations.

²⁶ The conceptualization of indirect discrimination is borrowed from Essed's (1996) discussion about the interplay of race, gender, and ethnicity.

narratives when talking about gender and ethics. Equally surprising, we did not find systematic differences between the narratives of physicists who work in elite universities and those from their counterparts who work in non-elite universities. Similarities in how these physicists discussed gender and ethics may be partly due to the similar gender stratification and masculine culture in academic physics in both non-elite and elite universities in the US and the UK. The nuanced differences in the particular type of gender-blind ideology that American and British physicists adopt implies that US and UK physicists may experience different types of gender socialization.

Future studies should consider the following limitations of this study; even though we adopt a comparative perspective, our comparison is limited to developed Western countries where gender segregation is particularly salient. Future studies should explore whether scientists in, for example, Eastern countries—nations with a different scientific infrastructure and often different approaches to gender relations—interpret gender and ethics in a way that is similar to their Western counterparts. And despite our efforts to over-sample female scientists, they are still vastly underrepresented in our respondent population. Future scholars might more specifically examine how female physicists interpret gender and ethics.

Our analysis shows that physicists value science ethics, but conceptions of science ethics intersect with the masculine disciplinary culture in academic physics and become a locus that disadvantages female physicists. Future research should also examine the relationship between gender and ethics in other masculine high-status disciplines, such as engineering. Our findings lay the groundwork for the beginning of a research agenda that takes seriously the importance of how gender shapes ethics in science and engineering.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Informed consent was obtained from all individual participants included in the study.

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