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Green for All? Gender Segregation and Green Fields of Study in American Higher Education

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ABSTRACT

Using the example of green fields of study in higher education, which emerged largely in response to the growing prominence of the environmental movement over recent decades, this article posits that new and emerging fields of study can be an important source of change in gender segregation across fields of study. We suggest that new and emerging fields of study, when framed outside of existing gender divisions, may transcend established gender divisions and be characterized by greater gender integration in both STEM and non-STEM disciplines. Patterns of gender segregation among over 9 million bachelor's degree recipients between 2009 and 2013 confirm that green programs are systematically characterized by greater gender equality relative to non-green fields, regardless of their STEM classification. Further, the more gender imbalanced the "parent" field, the greater the difference we find in the gender composition of green and non-green programs. These results imply that green programs are promoting greater gender equality across the higher education system, underscoring the effect of the organizational structure of higher education, such as the structure of fields of study available to students, on gender segregation in the academy.

KEYWORDS: higher education; fields of study; gender segregation; STEM fields; green movement.

The environmental movement is an omnipresent force for social change, diffusing across a wide range of social institutions. The first decade of the twenty-first century was characterized by record levels of public awareness and concern for environmental issues, and ever growing demand for green and more sustainable products, materials, and production (Dunlap and Mertig 1991; Wolf and Moser 2011). Changes in lifestyle choices and preferences were met with substantial increases in government and private sector investment in the new and emerging "green economy" over the past few decades, creating new job opportunities that may be particularly valuable for college-educated individuals (Strietska-Ilina et al. 2011). Many college students and young people today actively embrace sustainable choices and products, participating in the growing green economy.

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Colleges and universities responded to the environmental movement in ways that mirror the efforts of other large institutions, including such tangible initiatives as energy conservation programs and LEED certification for capital projects (Cortese 2003; Wright 2010). But the response of higher education was also intellectual, with the creation and expansion of new academic programs and even entirely new fields of study that meet changing student and labor market demand for green skills and knowledge. Green programs emerged quickly across a variety of fields, levels, and institution types in higher education. They include specialized programs in natural science-related fields such as environmental studies, environmental sciences, sustainability studies, environmental engineering and forestry, as well as programs with a more social scientific or professional focus like environmental law, sustainable management or development, and environmental education. Although some green programs predated the environmental movement, their prevalence, popularity, framing, and spread is new in higher education.

How do changes in the curriculum offering in higher education, especially ones associated with a powerful social movement, impact well-established patterns of social stratification in higher education? On one hand, curriculum differentiation can enhance stratification if the norms of participation in new fields of study mimic those of their more established "parent" fields. Yet, on the other hand, new and emerging fields of study can also disrupt existing norms of participation and consequently generate change in stratification patterns in higher education. New and emerging fields may lack existing norms of participation, and can be framed outside of existing group divisions, thereby transcending existing patterns of stratification. In such cases, changes in pattern of stratification in higher education may not only result from new generations of students entering higher education, but also from the evolution of course and degree offerings available to students.

In this article, we use the case of the emergence and expansion of green fields of study in higher education to examine whether and how new and emerging fields of study impact existing patterns of social stratification. We focus on whether these changes in the curriculum influence one prominent and highly consequential aspect of stratification in U.S. higher education: gender segregation by fields of study. Despite the reversal of the gender gap in bachelor's degree attainment over the past two decade (Buchmann and DiPrete 2006), women are underrepresented in many fields in the sciences, technology, engineering, and mathematics (hereafter "STEM"), which are associated with the highest economic returns to an undergraduate education (Charles and Bradley 2009; Mann and DiPrete forthcoming). Men, by contrast, are underrepresented in most social sciences, education, and health-related fields (England and Li 2006; Jacobs 1996; Mann and DiPrete forthcoming; Morgan et al. 2013; Xie and Shauman 2003; Gerber and Cheung 2008; Charles and Bradley 2009). We therefore assess whether green fields of study in higher education are systematically characterized by greater gender equality, both in STEM and non-STEM disciplines. We do so using data collected by the Department of Education on all bachelor's degree recipients between 2009 and 2013 at all U.S. accredited four-year colleges through the Integrated Postsecondary Data System (IPEDS).

Our results show that both STEM and non-STEM fields of study that are associated with the green movement are systematically characterized by greater gender equality than non-green fields of study. We also find that the more gender imbalanced the "parent" field is, the greater the difference in gender composition between its constituent green and non-green programs. These results imply that the green movement in higher education contributes to gender equality primarily by increasing the representation of women, or men, in fields characterized by high gender imbalance, like engineering, education and health professions, as well as by adding new fields that are lacking established gendered norms of participation, such as sustainability studies or environmental sciences. In addition, the green movement expands fields characterized by gender balance, like biology and life sciences. These results underscore the importance of the interplay between social movements, curricular offerings, and student choice for understanding change and stability in gender stratification patterns in higher education.

THE ENVIROMENTAL MOVEMENT AND GREEN FIELDS OF STUDY

The curriculum of American higher education is far from static—rather, it is constantly evolving in response to a variety of interrelated factors such as student demand, technological innovation, and institutional resources. Research in organizational behavior demonstrates that the activity of organizations such as colleges and universities are highly influenced by changes in their technical and normative environments, such as material resources, workforces, customer bases and tastes, and market demands (Kraatz and Zajac 1996; Pfeffer and Salancik 1978; Selznick 1957). Changes in the technical, legal, and normative environments, including those related to external social movements, require organizations to improvise, deviate from their original goals, or to adopt new organizational structures in order to survive. The response of higher education to student demand, changing social norms, and new technologies can be seen in the changing course catalogs of most research universities over the course of the twentieth century with the addition or decline of various fields, including home economics, women's studies, labor relations, and epidemiology (Geiger 2004; Jacobs 1996; Kerr 2001; Olzak and Kangas 2008).

The prevalence of the environmental movement since the late twentieth century is an example of external social pressures that can impact the organization of colleges and universities. Scholars have documented the increasing prevalence of the "green" movement, which has undergone a process of institutionalization from an outside activist movement to a mainstream phenomenon (Bosso 2005) and resulted in changes to the cultural and intellectual environment in which universities operate (Frank, Robinson, and Olesen 2011). Firms have expanded their efforts to appear as sustainable, as indicated by increased sustainability reporting and certification (Kolk 2004; Rondinelli and Vastag 2000). Worldwide public and private sector investment in sustainable products and alternative energy sources reached an all-time high in 2015, fueling the creation of countless new "green jobs" (Frankfurt School of Finance and Management 2016). And, at the individual level, green lifestyle choices have become more commonplace as consumers prioritize and internalize environmental concerns (Berger 1997; Haanpää 2007).

The growing prevalence of the green movement provides a direct incentive for higher education to create programs that specialize in conveying and developing "green" knowledge, resulting in the creation of new degree programs and the reframing of existing ones. The number of distinct green fields of study offered by U.S. four-year colleges increased from 47 in 2002 to 59 in 2013—an increase of 26 percent—relative to only a 6 percent increase in the number of distinct non-green fields (IPEDS data, authors' calculations). Some green programs had their roots in disciplines in the life sciences, arguably an area of STEM characterized by more egalitarian gender norms and student composition than those in the engineering and computer sciences. But most green programs are offshoots of other fields, including architecture, law, education, management, and engineering, or entirely new in nature, like suitability studies or environmental science.[1]

The rapid institutionalization of the green movement in higher education provides a unique opportunity to document the effects of new and emerging fields of study in higher education on gender segregation by fields of study. New and emerging programs, such as queer studies and quantitative biology, are often hard to track—they are small and experimental by nature, and thus usually disappear after a short period of time or get grouped together with more traditional fields in both micro- and macro-level data on higher education. And, as is the nature of change in fields characterized by a strong normative environment, like higher education, they emerge slowly and unevenly across different parts of the system before they become institutionalized (Scott 1995).

This is not necessarily the case for green fields of study. Since green fields of study evolved largely in response to a powerful social movement, they expanded and institutionalized across higher education over a relatively short period of time. Even though green fields tend to be smaller than more

1 Although the focus of this article is on the bachelor's degree level, it is noteworthy that the green movement is becoming institutionalized at all levels of the educational system, ranging from middle school science courses to new PhD programs.

established fields, the institutionalization of these fields can be seen in the addition of distinctly green fields of study to the 2010 Department of Education Classification of Instructional Programs (CIP), including "Environmental Education," "Energy, Environment, and Natural Resources Law," "Environmental Psychology," and "Sustainability Studies" (U.S. Department of Education 2010). Insofar as officially updated classifications can tell us something about the organizational landscape of higher education, the changes between the 2000 and 2010 CIP classification schemes suggest that green fields of study have become institutionalized in U.S higher education. Therefore, we can use official data on green fields of study to examine how changes in the curriculum offerings in higher education can impact patterns of gender stratification in higher education.

GREEN FIELDS OF STUDY AND GENDER SEGREGATION

Traditionally, most explanations for gender disparities in field of study selection, and especially the underrepresentation of women in STEM fields, focus on stages of the life course prior to college enrollment in which the mechanisms that generate gender segregation are embedded within students themselves. These explanations include gender differences in math preparation and ability (Arcidiacono, Hotz, and Kang 2012; Ayalon 2003; Jonsson 1999; Margolis et al. 2008; Porter and Umbach 2006; Turner and Bowen 1999) biased self-assessment of mathematical ability (e.g., Corell 2001, 2004), widely shared cultural beliefs and stereotypes (e.g., Eccles and Jacobs 1986; Steele and Aronson 1995), differences in family-work values and expected labor market attachment (Ceci and Williams 2010; Xie and Shauman 2003), as well as differences in the social penalty associated with choosing a STEM field and occupation (Seymour and Hewett 1998; Simpson 2001). These gender differences in preparation, socialization, and perception inform students' social identities and beliefs about gender-suitable careers and occupations, and subsequently impact field of study selection in college (Morgan et al. 2013; Mann and DiPrete forthcoming). Thus, as long as these pre-college gender differences persist, gender segregation is not expected to disappear (Barone 2011; Charles and Bradley 2002, 2009).

Students' dispositions and aspirations, however, are only part of the process of field of study selection. Once in college, students look at their institution's course catalog, consult with their friends, families, academic advisors, and classmates about the different programs available, and eventually choose a field of study from the available set of options at their respective institution. Through this process, students learn about the content of fields, the social and academic climate within them, the way the different fields and the students within them are perceived, and how compatible they are with their (gendered) aspirations and dispositions (e.g., Morgan 1992; Steele, James, and Barnett 2002; Xie and Shauman 2003). As a result, the ways fields are framed and perceived have an important role to play in shaping gender difference as they evoke certain degrees of gender identity. Perceptions of gender bias can be slow to change but are not static and play an important role in shaping new institutional environments (Ridgeway 2011).

The idea that fields themselves evoke gendered identities is present both implicitly and explicitly in research on gender segregation by fields of study. Maria Charles and Karen Bradley (2009), for example, suggest that the curricular choices men and women make can largely be viewed as an expression of students' gendered social identities, in which "gender-essentialist stereotypes and dispositions combine with norms of self-expression to intensify gender typing of curricular choice . . ." (p. 928). Consistent with this argument, Carlo Barone (2011) shows that much of the association between gender and field of study selection can be understood by two independent gender divides: "humanistic" versus "scientific" fields, and "care-oriented" versus "technical" fields. Per this line of research, we can expect fields that are framed and perceived within these existing gendered paradigms to evoke strong gender identities and have a disproportionately high representation of either men or women.

The influence of the perception of fields on their gender composition may shed light on the high persistence of gender segregation by field of study despite dramatic improvements in women's math achievement in high school and growing labor market opportunities for women (e.g., Barone 2011; Charles and Bradley 2002, 2009; Correll 2001, 2004; England and Li 2006; Mann and DiPrete forthcoming; Turner and Bowen 1999), as well as increasing enrollment in STEM fields by women in absolute terms (Ramirez and Wotipka 2001). But, more important, it can also point to an important source of change in the pattern and magnitude of gender segregation by field of study over time. Just as social changes have affected the pool of students entering higher education, they also impact the ways in which academic disciplines are perceived and framed. As Charles and Bradley (2009) note:

> the content of gender-essentialist stereotypes shows much consistency across time and space . . . (b)ut historical and comparative case studies also reveal significant fluidity. For example, different versions of masculinity (emphasizing muscularity or abstract logic) have been more or less salient in different fields, depending in part upon the demographic and social pressures operative at the time of each field's development or expansion (p. 928).

Thus, the curriculum of higher education does not emerge in a vacuum, but rather reflects the needs, concerns, and demands of society at large. An example of the relationship between changes in curricular offerings and gender segregation can be seen in the emergence and expansion of business fields in the mid-1980s, which led to overall desegregation in field of study selection across the entire higher education system (England and Li 2006; Jacobs 1995; Mann and DiPrete forthcoming).

Although existing theories leave the door open to changes in the social context of academic fields affecting perceptions and stereotypes, they stop short of making predictions about the impact of entirely new movements and disciplines. Most existing research suggests that diversification of curricular offerings will enhance gender segregation because scholars assume that new fields emerge largely within existing gender paradigms (e.g., Bradley 2000; Charles and Bradley 2002, 2009) or draw upon existing frames (Ridgeway 2011). This unidirectional view of change in curricular offerings, we argue, may overlook important variation in the ways in which new fields emerge, and how that variation may affect gender distributions across fields. What happens when a new social and technological movement emerges and disrupts established assumptions and stereotypes about disciplines, and even creates entirely new fields?

We submit that new and emerging fields are more likely to lack established stereotypes and norms, and therefore may attract a broad distribution of students. Meanwhile, norms within existing fields that join the green movement will adapt to external forces. As a new social phenomenon, the environmental movement enables fields to emerge outside of existing gender paradigms—for example being simultaneously care oriented and technical, or both humanistic and scientific—and therefore transcend traditional gender divisions.[2] The framing of fields (e.g., care, technical/humanistic, or scientific) may not be orthogonal in new and emerging green fields, and thus has the potential to transcend existing gender divisions.[3]

While we do not argue that green fields of study are free of gender frames or stereotypes, we expect that the forces explained above will give green fields, on balance, a character that is relatively less tilted toward norms favoring one particular gender. That is, we expected green programs that emerge

2 According to Barone (2011), "we could anticipate a female preference also for fields like psychology or medicine that give access quite often to jobs characterized by their symbolic affinity with traditional caring roles, given their specific orientation toward the well-being and personal development of customers" (p. 159). Although care orientation has traditionally been associated with care for people, there is no reason to assume that "care" for the natural world will not produce similar effects. Indeed, research suggests that women exhibit higher levels of environmental concern than men, and that concern results in the adoption of environmentally friendly behaviors and attitudes at higher rates (Diamantopoulos et al. 2003; Luchs and Mooradian 2012).

3 It can be the case that some existing fields with a tie-in to the environmental movement prior to the growth in attention to environmental issues in recent years may have had a more progressive character, making them less gender typed from the beginning, but since green fields emerge in a range of broad disciplinary categories—gender typed and not (i.e., engineering, education, chemistry, etc.)—the specific demographics of the "parent" field cannot fully account for the distribution of students within green fields.

from both female-dominated fields like humanities, and male-dominated fields like engineering to have more equal gender composition than their "parent" fields. In addition to the hybrid nature of some new green fields of study, it should be noted that well-established fields fitting within the green paradigm in the biological sciences have historically been more gender balanced than other STEM disciplines. This tradition may have diffused to related fields within the environmental program movement as they borrowed students, faculty, and ideas from the life sciences. Nonetheless, since only a small fraction (only 3 out of 61) of the green CIP codes we observe in U.S. higher education evolved directly from biological sciences per se, the patterns we describe here cannot be reduced to the effect of biological fields alone.

Focusing on responses to changes in the curriculum can shed light on the role of the organization in promoting change in gender segregation by field of study. Our goal here is to both expand existing scholarship on gender stratification by explicitly conceptualizing change in the segregation regime rather than stability, as well as to highlight the role of changes in the organizational structure of higher education (measured here as curricular offerings) in shaping the distribution of students across fields. To this end, we investigate two related empirical questions: (1) How did green fields of study expanded in U.S. higher education over the first decade of the twenty-first century? and (2) To what extent are green fields of study characterized by greater gender equality than non-green fields?

DATA, VARIABLES, AND METHOD

Data and Sample

Our empirical research is based on data from the Integrated Postsecondary Education Data System (IPEDS). The IPEDS is a set of publicly available data files collected by the U.S Department of Education that contain detailed information on all Title-IV eligible institutions in the United States. We use information drawn from IPEDS's institutional characteristics, enrollment, and completion files collected between 2009 and 2013. These files contain detailed and consistent information on the demographic and organizational characteristics of each Title IV institution offering four-year courses of study. The files also contain detailed information about all undergraduate academic programs (college majors) at each eligible institution, including the detailed classification of instructional programs (CIP) code and the number of degrees awarded in each program by gender.

Our analyses focus on all detailed instructional programs (measured using the six-digit CIP codes) offered at the bachelor's level in all Title IV-eligible four-year institutions between 2009 and 2013 that awarded at least one degree over that period. We analyze information about degree recipients at 78,300 unique degree-granting programs offered in 2,850 four-year postsecondary institutions (hereafter "program-institution"), and are classified into 1,131 unique 6-digit CIP categories. Roughly 9 million bachelor's degrees were awarded at these programs between 2009 and 2013, of which 57 percent were awarded to women. We supplement these data with IPEDS information collected between 2002 and 2008 to track the progression of green fields of study in higher education, although the reader should be aware that the inclusion of new fields of study may not have precisely corresponded to the date that the first degree program was launched (e.g., sustainability studies) and thus we interpret these results cautiously.[4] Since many green fields of study were added to the 2010 CIP classification, we cannot extend our analyses of trends in the distribution of students by gender to the entire period for which there is CIP data.

The main advantage of using IPEDS data to study gender segregation by field of study is that it contains information on the entire universe of Title IV institutions in U.S. higher education and thus circumvents the need to infer from a sample of students or institutions. Thus, the IPEDS provides an accurate snapshot of gender segregation in fields of study in U.S. higher education. However, because the IPEDS does not contain micro-level information on students' behaviors, preparation, or choices,

4 Some fields from the 2000 classification were changed or removed altogether in the 2010 classification.

we cannot assess the micro-level mechanisms that channel men and women to different fields of study. Most importantly, we cannot observe the ways in which students perceive different green and non-green programs. While this is an important limitation, it nonetheless exists in other studies that rely on macro-level survey data to understand macro-level patterns of gender segregation (e.g., Barone 2011; Charles and Bradley 2002, 2009). Taking these limitations into account, we focus on describing trends in the association between the classification of fields and their gender composition.

Main Variables

Our outcome of interest—*the gender composition of programs*—is measured as the percentage of degrees in each program-institution that were awarded to women. To *obtain field of study classifications*, we collapsed the detailed codes for all instructional programs (6-digit CIP codes) in the IPEDS data set into four groups: (1) green STEM programs; (2) non-green STEM programs; (3) green non-STEM programs; and (4) non-green non-STEM programs. We use the broad categories defined by the U.S. Economics and Statistics Administration's 2010 report on green jobs, "Measuring the Green Economy," to distinguish between green and non-green fields. This report identifies five main types of economic activity that could be considered green (p. 8): (1) pollution control, (2) renewable and alternate sources of energy, (3) energy conservation, (4) resource conservation, including recreation, and (5) environmental assessment, including nonprofit environmental advocacy. Using the descriptions of fields of study provided in the CIP codebook (U.S. Department of Education 2010), we determined if each 6-digit instructional program is explicitly and directly related to one of these five economic areas.

To classify instructional programs as STEM or non-STEM we followed the National Science Foundation's definitions of STEM fields (U.S. National Science Foundation 2005), excluding several 6-digit CIP codes that clearly focus on policy and management. Overall, we identify 61 CIP codes as green, of which 23 are in non-STEM disciplines and 38 are in STEM disciplines. In addition, green fields are also categorized under a classification of parent 2-digit CIP fields to help determine whether the disciplinary foundations of green fields affect their demographic compositions. A full list of the instructional programs categorized as green, their STEM classification, and CIP codes are provided in Table 1.

Adjustment Variables

Our models adjust for several characteristics that vary across instructional programs and across colleges and universities that can potentially influence the gender composition of fields. *Program-level adjustments* include the size of the program-institution (measured by the number of students awarded a degree in each program), the proportion of R1 universities offering degrees in the program, and the proportion of all four-year colleges and universities offering degrees in the program. *College-level adjustments* include the size of the college (measured by the total number of students that were enrolled in the institution in 2010), control of college (public, private non-profit, private for-profit), the number of unique programs offered in the college, the overall gender composition of graduates in the college, and whether it is classified as a research university (R1) according to the 2010 Carnegie Classification.

Analytic Approach

The empirical investigation consists of several stages. First, we document changes in the prominence and spread of green programs in higher education using descriptive data from 2002 to 2013, as well as examine several differences in the organizational characteristics of green and non-green fields in the main sample (2009-2013).

Next, we turn to assess differences in the gender composition of green fields of study by fitting several multilevel models predicting the share of degrees in a given program-institution unit that were awarded to women. These models both capture the structure of the data (i.e., programs nested in institutions), and allow the effect of green fields to vary by institution (by using a random slope

Table 1. Detailed Six-Digit CIP Codes of Green Programs and Their STEM Classification

Non-STEM green programs
03.0101-Natural Resources/Conservation, General
03.0103-Environmental Studies
03.0201-Natural Resources Management and Policy
03.0204-Natural Resource Economics
03.0206-Land Use Planning and Management/Development
03.0207-Natural Resource Recreation and Tourism
03.0208-Natural Resources Law Enforcement and Protective Services
03.0299-Natural Resources Management and Policy, Other
03.0506-Forest Management/Forest Resources Management
04.0401-Environmental Design/Architecture
13.1337-Earth Science Teacher Education
13.1338-Environmental Education
19.0601-Housing and Human Environments, General
19.0604-Facilities Planning and Management
19.0699-Housing and Human Environments, Other
22.0207-Energy, Environment, and Natural Resources Law
30.3201-Marine Sciences
30.3301-Sustainability Studies
31.0101-Parks, Recreation and Leisure Studies
31.0301-Parks, Recreation and Leisure Facilities Management, General
31.0399-Parks, Recreation and Leisure Facilities Management, Other
31.9999-Parks, Recreation, Leisure, and Fitness Studies, Other
51.2202-Environmental Health
STEM green programs
03.0104-Environmental Science
03.0199-Natural Resources Conservation and Research, Other
03.0205-Water, Wetlands, and Marine Resources Management
03.0301-Fishing and Fisheries Sciences and Management
03.0501-Forestry, General
03.0502-Forest Sciences and Biology
03.0508-Urban Forestry
03.0509-Wood Science and Wood Products/Pulp and Paper Technology
03.0510-Forest Resources Production and Management
03.0511-Forest Technology/Technician
03.0599-Forestry, Other
03.0601-Wildlife, Fish and Wild lands Science and Management
03.9999-Natural Resources and Conservation, Other
14.0805-Water Resources Engineering
14.1401-Environmental/Environmental Health Engineering
14.2401-Ocean Engineering
14.3401-Forest Engineering
14.3901-Geological/Geophysical Engineering
15.0501-Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology
15.0503-Energy Management and Systems Technology/Technician
15.0505-Solar Energy Technology/Technician

(*continued*)

Table 1. Detailed Six-Digit CIP Codes of Green Programs and Their STEM Classification (continued)

15.0506-Water Quality and Wastewater Treatment Management and Recycling Technology/Tech
15.0507-Environmental Engineering Technology/Environmental Technology
15.0508-Hazardous Materials Management and Waste Technology/Technician
15.0599-Environmental Control Technologies/Technicians, Other
26.1301-Ecology
26.1305-Environmental Biology
26.1307-Conservation Biology
40.0401-Atmospheric Sciences and Meteorology, General
40.0404-Meteorology
40.0499-Atmospheric Sciences and Meteorology, Other
40.0601-Geology/Earth Science, General
40.0602-Geochemistry
40.0603-Geophysics and Seismology
40.0604-Paleontology
40.0605-Hydrology and Water Resources Science
40.0607-Oceanography, Chemical and Physical
40.0699-Geological and Earth Sciences/Geosciences, Other

for green classification). At the core of these analyses are two main predictors and their interaction terms: (1) a dummy variable indicating whether or not the program is green; and (2) a dummy variable indicating whether or not the program is in a STEM discipline. Importantly, the interaction terms allow us to compare green and non-green programs across STEM and non-STEM fields. We also account for differences between institutions, and their association with the gender composition of programs within them by estimating the intercept and the effect of green as random effects.[5] Finally, we add adjustments for the program-level and college-level characteristics mentioned above to net out the potential impact of institutional- and program-related differences on the association of interest. We further explain the progression of the models in the results section.

Finally, we examine whether green fields of study differ from non-green fields of study on another aspect of gender equality in higher education: gender integration. We calculate two commonly used segregation indices—the index of dissimilarity (D) and the index of association (A)—for green and non-green programs across STEM and non-STEM fields. The index of dissimilarity indicates the percent of women (or men) that would have to switch programs for the distribution of men and women across fields to be equal. The index of association (A) can be interpreted as the factor by which women (or men) are overrepresented in the average field.[6] For comparison, we also calculated the indices for all programs. Together, these indices give us an idea of the degree to which men and women occupy similar spaces in higher education.

RESULTS

Green Fields of Study in Higher Education

The green movement became increasingly prevalent across higher education over the past decade. Table 2 shows trends in the presence of green programs in higher education between 2002 and 2013.[7]

5 As a sensitivity analysis, we estimated a series of fixed effects models (not shown, available from authors), and the results were virtually the same.

6 See chapter 2 in Charles and Grusky (2004) for further explanation of these indices.

Table 2. Green Programs in Higher Education, 2000-2013

	Percent of Four-Year Colleges That Offer Documented Green Programs	*Number of Green Programs in Higher Education*	*Number of Bachelor's Degrees Awarded in Green Programs*
2002	34	1,558	19,484
2003	39	1,859	21,010
2004	39	1,998	21,228
2005	40	2,061	21,703
2006	40	2,109	21,947
2007	39	2,116	22,825
2008	39	2,193	23,737
2009	39	2,250	25,470
2010	38	2,268	27,774
2011	38	2,348	30,955
2012	39	2,476	33,606
2013	39	2,545	35,311

Source: IPEDS institutional characteristics and completion files, 2002-2013

The proportion of four-year colleges that offer any green field of study increased only slightly over the last decade, from about a third of all institutions in 2002 to about 39 percent in 2003, and then remaining roughly stable through 2013. However, the number of programs offering degrees in green fields in higher education increased steadily throughout the period, from 1,558 programs to 2,545. Therefore, although the spread of green undergraduate degree programs throughout the system stagnated, the number of green programs within a typical institution touched by the green movement increased. In other words, institutions that offered green fields at the beginning of the decade tended to offer a more diverse set of green programs by the end of the decade.

The growing prevalence of green programs is also visible in the steady increase in the number of bachelor's degrees awarded in green programs. The total number of degrees awarded in green programs increased by about 81 percent, from 19,484 in 2002 to 35,311 in 2013. This far exceeded the growth rate of non-green fields: the overall number of degrees awarded in non-green programs increased by 39 percent (from 1,351,246 to 1,875,513). The dramatic increase in the number of undergraduate degree recipients in green programs accompanied a steady increase in the number of green programs offered across institutions, demonstrating the institutionalization of green fields of study in American higher education.

As with any relatively new and expanding set of institutions, green fields of study are likely to differ, in some respects, from more established programs in their characteristics. Table 3 shows a comparison of several characteristics of green and non-green programs across the STEM (Panel A) and non-STEM (Panel B) disciplines, including (1) the total number of graduates in each program, (2) the proportion of universities that offer each given program; and (3) the proportion of colleges and universities offering each program that are classified as research universities (R1). While this is certainly not an exhaustive list of all factors that may differ between green and non-green fields, it nonetheless provides a snapshot of the characteristics of these new and emerging programs.

As expected, green programs are smaller on average than non-green programs, both in STEM and in non-STEM disciplines (averaging just 50 and 75 bachelor's degree recipients in STEM and non-STEM green program between 2009 and 2013, relative to 100 and 121 for the average non-green

7 It is important to note that the estimations for 2002-2008 are conservative since many green fields were not yet included in the CIP classification until a major revision in 2009.

Table 3. Characteristics of Green and Non-green Programs, IPEDS 2009-2013

	Non-green Fields		*Green Fields*	
	Mean	*(sd)*	*Mean*	*(sd)*
STEM fields				
Number of degrees awarded in program	99.54	185.93	49.46	66.01
Proportion of institutions offering program	.18	.17	.10	.07
Proportion of institutions offering program that are research universities	.33	.21	.42	.17
Size of the institutions offering program (measured in total student enrollment)	14,083.13	19,772.81	16,213.67	15,552.90
Non-STEM fields				
Number of degrees awarded in program	120.72	318.93	74.87	120.99
Proportion of institutions offering program	.19	.17	.08	.06
Proportion of institutions offering program that are research universities	.23	.12	.31	.14
Size of the institutions offering program (measured in total student enrollment)	11,607.95	17,510.41	14,993.78	22,587.36

Notes: Averages are calculated across the population of programs-institutions. Statistics can be interpreted as the characteristics of the average green and non-green program.
Source: IPEDS institutional characteristics, completion and enrollment files 2009-2013

STEM and non- STEM program). Green programs also differ in the characteristics of their host colleges and universities relative to non-green programs. The typical green program is offered by a smaller share of all institutions relative to the typical non-green program both in STEM and non-STEM disciplines—while nearly all four year colleges and research universities have English departments, a specialized discipline like forestry will naturally appear in a smaller subset of institutions. Yet, green programs in both STEM and non-STEM disciplines are concentrated at larger institutions, including a disproportionately high number of research (R1) universities. These trends are consistent with the organizational literature, which suggests that institutional change often originates from the most established organizations (e.g., research universities) and later spread throughout the organizational field (i.e., Scott 1995; Tolbert and Zucker 1983). Because research universities tend to have more resources and face fewer risks, they may be better positioned to adapt to labor market changes and innovate in their curricular offerings (Geiger 2004).

Overall, Table 2 and 3 suggest that even though green programs in higher education represent a small fraction of all degrees awarded and programs offered, they are becoming more prevalent over time, with a faster growth rate than non-green programs. These new and emerging programs tend to be smaller on average than other more established programs, and are disproportionately concentrated at large research universities. The question is now whether traditional gender divisions, especially those across STEM and non-STEM lines, differ in green and non-green fields?

Green Fields of Study and the Gender Composition of Degree Recipients

The ubiquity of gender segregation by field of study in higher education manifests itself in the gender composition of recent bachelor's degree recipients in the various fields presented in Table 4. These trends should come as no surprise—women are overrepresented in psychology (77 percent), education (79 percent), and health professions (85 percent), and are underrepresented among degree

Table 4. Number and Gender Composition of BA Degree Recipients, 2009-2013, by Field of Study

Field of Study	*Total Degrees Awarded in Field*	*Percentage of Degrees in Field Awarded to Women*
Non STEM fields		
Health profession	832,858	85
Education	525,995	79
Psychology	543,799	77
Multi/interdisciplinary studies	197,929	68
Communication	448,678	63
Humanities	759,921	62
Visual & performing art	478,363	61
Vocational fields	744,904	61
Professional fields (architecture, legal profession and studies)	70,921	51
Social sciences	883,486	49
Business, management, marketing	1,831,271	48
Natural resources and conservation	72,198	48
Other specialized fields (construction trades, transportation, military technologies)	27,575	11
STEM fields		
Biological, biomedical science and agriculture	587,889	58
Mathematics and statistics	94,705	43
Physical sciences	137,272	41
Computer and information sciences	239,759	18
Engineering / engineering tech.	497,675	18
Total	8,975,198	57

Source: IPEDS completion files 2009-2013

recipients in engineering (18 percent) and computer and information sciences (18 percent). Other fields on both sides of the STEM divide have more balanced gender compositions, such as biological sciences and agricultural fields (grouped together, 58 percent women), reflecting well-known trends of gender integration in these fields. Similarly, while math and the physical sciences still have relatively low percentages of women graduates (43 percent and 41 percent, respectively), the proportion of degrees awarded to women is substantially higher than in engineering and computer science fields.

The general patterns of gender segregation by field of study observed in Table 4 confirm that we are still far from gender equality in distributions, especially in STEM fields. This is especially the case when we consider broad aggregated categories of fields. However, these aggregated categories of fields mask a substantial degree of variation in the gender composition of more refined field categories. For instance, while only 17 percent of engineering degrees were awarded to women, 39 percent of degrees in biochemical engineering were awarded to women. Of course, focusing on more refined program categories pose many methodological challenges that have undoubtedly curtailed previous efforts to examine changes in gender segregation at the program level, especially in the absence of strong theoretical need to do so. Yet, it is exactly this variation within the aggregate field categories that is the focus of our investigation. We analyze the most detailed level of fields available to assess whether and how programs that offer green knowledge—both in STEM and non-STEM fields—differ systematically in their patterns of segregation than non-green fields.

Table 5. Coefficients from Multilevel Linear Models Predicting the Share of Bachelor's Degrees Awarded to Women by Program-Institution Between 2009 and 2013

	1	2	3	4	5	6
Intercept	.54***	.56***	.60***	.61***	.59***	.59***
	−.01	(.00)	(.00)	(.00)	(.01)	(.01)
Green program (green = 1)		−.10***	.00	−.13***	−.12***	−.12***
		(.01)	(.01)	(.01)	(.01)	(.01)
STEM discipline (STEM = 1)			−.24***	−.25***	−.24***	−.24***
			(.00)	(.00)	(.00)	(.00)
Green*STEM				.21***	.21***	.21***
				(.01)	(.01)	(.01)
Program-level adjustments						
Size of program						Yes
% R1 universities offering major						Yes
% Institutions offering major						Yes
Institution-level adjustments						
Institution size					Yes	Yes
Control of institution					Yes	Yes
% degrees awarded to women in the institution					Yes	Yes
Number of programs offered					Yes	Yes
Research activity of institution					Yes	Yes
Level 1 observations (programs)	78,300	78,300	78,300	78,300	78,300	78,300
Level 2 observations (institutions)	2,850	2,850	2,850	2,850	2,850	2,850
−2LL	−10,383	−10,231	−5,103	−4,896	−2,768	−2,708
Df	0	1	2	3	14	17

Note: Robust standard errors in parentheses.
Source: IPEDS 2009-2011
***$p < .01$ (two-tailed tests)

We examine variation in the gender composition of fields by estimating a series of nested multilevel linear models predicting the proportion of degrees in each program (within each university) that were awarded to women (Table 5). The multilevel models are especially suitable for the purposes of our investigation because programs are nested within institutions that differ in their characteristics in ways that can impact the distribution of students across fields. The multilevel models enable us to separate these two variance components (by estimating a random intercept), as well as to examine whether the association between green fields and gender composition differs by institution (by estimating a random slope for field green classification).

The first model in Table 5 is the baseline unconditional model that includes only an intercept that is allowed to vary between institutions (Model 1). According to this model, the average share of degrees awarded to women in the average program is 54 percent. The variance components from the unconditional model suggest that 69 percent of the variability of gender composition of programs is related to program-level factors, and 31 percent of the variability is related to differences between institutions. Model 2 in Table 5 includes a dummy variable indicating whether the program is green or not. The association between the classification of the program (i.e., green vs. non-green) and the gender composition of degree recipients in this model is also allowed to vary across institutions, although the results suggest that this association does not vary significantly from institution to institution. The results from this model indicate that the share of degrees awarded to women in green programs is about 10 percentage points lower than in non-green programs. Model 3 adds a dummy variable indicating whether the program is in a STEM discipline. As anticipated, being under the STEM umbrella has a strong negative association with the representation of women among the fields' degree recipients: the share of degrees awarded to women in STEM programs is about 24 percentage points lower than that in non-STEM fields, netting out the association between gender composition and a field's classification as green. However, this procedure neutralized the effect of green field status on the gender composition of programs. Because green programs are more common in STEM fields than in non-STEM fields (see Table 1), the negative association between green program and gender composition captured in Model 2 can be related to the overall lower representation of women in STEM fields rather than an effect of green field status per se.

To further examine this possibility, Model 4 adds an interaction term between the green classification of the program and its STEM classification. The main advantage of this interaction is that it allows for direct comparisons between green and non-green programs across STEM and non-STEM disciplines. Both the main effects for green and STEM fields and their interaction term are significant, suggesting differences between the four quadrants of interest. Overall, green fields both in STEM and non-STEM are characterized by more gender-neutral distribution of degree recipients than non-STEM fields. According to our model, the share of degrees awarded to women in green fields that are non-STEM is, on average, 13 percentage points lower than in non-STEM non-green fields. The share of degrees awarded to women in STEM fields that are not green is about 25 percentage points lower than non-STEM fields that are not green. Finally, the positive interaction term indicates that green fields of study are characterized by greater gender equality, both in STEM and in non-STEM. For example, the average share of degrees awarded to women in non-STEM programs that are not green is about 61 percent (see model intercept), while the average share of degrees awarded to women in non-STEM green fields is about 48 percent ($61-13 = 48$). Similarly, the average share of degrees awarded to women in STEM fields that are not green is about 36 percent ($61-25 = 36$). In comparison, the average share of degrees awarded to women in STEM programs that are green is 44 ($61-13-25+21 = 43$)—about 8 percentage points higher than in STEM non-green fields. To summarize, green programs have, on average, a more balanced gender composition than non-green programs, both in STEM and in non-STEM disciplines.

To account for the potential effect of differences between the institutions that offer green and non-green programs or the characteristics of the programs themselves, Models 5 and 6 add the set of adjustments for programs and colleges mentioned above. The inclusion of these controls did not impact the magnitude of the coefficients for green or STEM fields nor their standard errors. We conclude that the difference between green and non-green programs on both sides of the STEM divide goes above and beyond the measured characteristics of the programs and the institutions that offer them.

The gender balance of green fields of study can be related to the framing of green fields of study, as we argued above, but it can also be related to the composition of the "parent" field from which the green program emerged. That is, it is possible that green fields of study simply mimic the composition of the disciplines from which they emerge rather than disrupt existing patterns of participation. In this case, if more green programs emerge from fields that are characterized by a balanced gender composition, it can account for the results described in Table 5. To examine this possibility, Figure 1 graphs the average share of degrees awarded to women in fields that offer both green and non-green programs.[8] Focusing on these fields enables us to directly compare between the gender composition of green and non-green programs within each field.[9] If green fields of study disrupt existing patterns of participation, we would expect to see a difference between green and non-green programs, especially in fields that are characterized by high gender imbalance. Alternatively, if green fields of study

8 Note that the percentages in Figure 1 reflect the average degrees awarded to women in degree-institution unit, whereas the percentages in Table 4 are the overall degrees awarded to women in a given field.

9 The classification of aggregate fields is largely based on the two-digit CIP code and is consistent with the fields listed in Table 4.

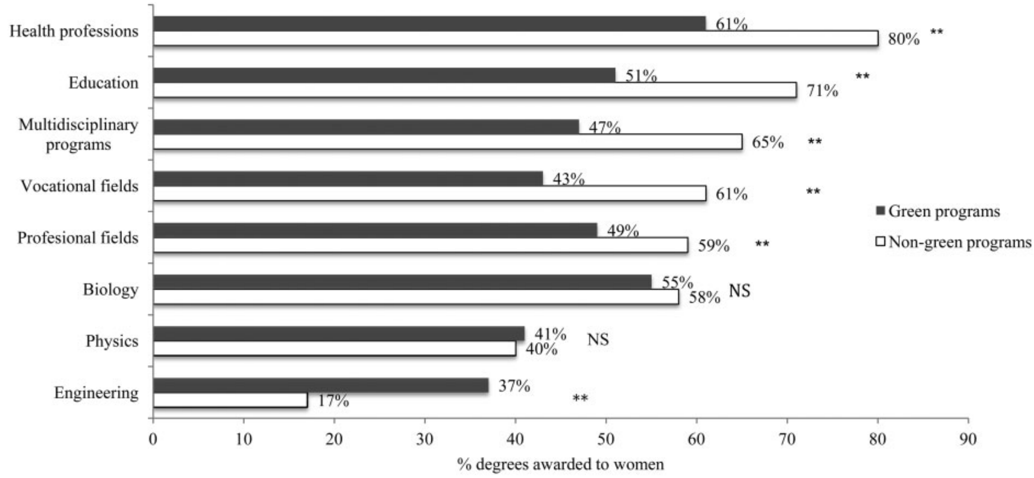

Figure 1. Averege Percentage of Women in Green and Non-green Programs in Selected Fields of Study

Note: ** Indicates $p < .05$ in a t-test performed to measure differences in the share of degrees awarded to women.
Source: IPEDS completion files 2009-2013

Table 6. Gender Segregation Indices for Bachelor's Degree Recipients 2009-2013, by Field Classification

	All Programs		*STEM Programs*		*Non-STEM Programs*	
	A	*D*	*A*	*D*	*A*	*D*
All programs	3.53	.40	3.18	.43	3.18	.38
Green programs	2.26	.27	2.18	.26	2.36	.26
Non-green programs	3.57	.40	3.26	.44	3.18	.38

Source: IPEDS completion files 2009-2013

simply mimic the norms of participation of their parent discipline, we would expect to see similar patterns of participation across green and non-green fields.

The results of this comparison lend support to the first possibility: the difference between green and non-green fields is larger in fields characterized by greater overall gender imbalance (i.e., either female dominated or male dominated). For example, in engineering fields, where only 17 percent of degrees are awarded to women in non-green fields, we see marked improvement in engineering green fields: 37 percent of degrees in green engineering programs are awarded to women—a difference of 20 percentage points. Similarly, in education and health professions, which are characterized by high representation of women (71 percent and 80 percent, respectively), green programs are substantially and significantly more gender equal, with only 51 percent and 61 percent of their degrees awarded to women, respectively. In the biological and physical sciences, however, which are characterized by more gender equal distribution in the parent field (58 percent and 40 percent, respectively), we see no significant differences in the gender composition of students in green and non-green programs. These patterns imply that green programs disrupt existing patterns of gender participation rather than mimic existing ones.

Taken together, the results from Table 5 and Figure 1 suggest that green programs are characterized by more equalized gender composition relative to non-green programs, especially in fields characterized by high gender imbalance. Although green programs that borrow norms from biological sciences have a positive influence on the gender composition of green programs, the positive effect of green fields on gender composition reported in Table 5 is likely attributed to the characteristics of green fields rather than their parent field.

Green Fields of Study and Gender Integration

So far we have showed that most green fields of study, especially those that emerge from highly gender-imbalanced parent fields, are characterized by more gender-equal distributions of their graduates. In this section we focus on another important aspect of gender equality in higher education: gender integration, measured as the degree to which men and women occupy similar spaces in higher education. From this perspective, the question is whether men and women are more likely to share the same programs in green fields than they are in non-green fields. We explore this question using two commonly used segregation indices: the index of dissimilarity (D) and the index of association (A) (see analytic strategy section for further explanation). We calculate the indices for all green and non-green programs, and then for STEM and non-STEM green and non-green fields separately. The indices are presented in Table 6.

The results in Table 6 confirm that green fields of study are characterized by greater degree of gender integration, both in STEM and non-STEM fields. The value of both indices is lower for green programs than for non-green programs both in STEM and non-STEM programs. About 40 percent of men (or women) will have to switch program in order to be equally distributed across programs. Yet, when we consider only green fields, only 27 percent of men (or women) will have to switch in order to be equally distributed. Similarly, men or women are overrepresented by a factor of 3.57 in the average non-green programs, but they are only overrepresented by a factor of 2.26 in the average green program.

We see a similar story when looking within STEM and non-STEM fields. Only 26 percent of men or women who study in green STEM programs will have to switch program in order to be equally distributed across these programs, while 44 percent of men and women in non-green STEM programs will have to switch their program. Similarly, men are overrepresented by a factor of 2.18 in the average green STEM field, but overrepresented by a factor of 3.26 in the average non-green STEM field. The results are very similar in non-STEM programs: the D index for green programs is .26 in comparison to .38 for non-green non-STEM fields. The A index for green non-STEM fields is 2.36 in comparison to 3.18 in non-green non-STEM fields.

The results of the multilevel models and the segregation indices provide compelling evidence that green fields of study are systematically characterized by greater gender equality and integration than non-green fields. Together with the comparisons presented in Figure 1, these results imply that green fields of study are a disruptive force to existing norms of gender stratification in higher education. Although these results are not indicative of any direct causal effect of the presence of green fields on men's and women's choices of degree program, they are consistent with the argument that new and emerging fields in higher education can systematically depart from traditional patterns of gender segregation by field of study. Of course, other new programs may also depart from traditional gender divisions. However, since new programs tend to be small and experimental in nature, it is hard to assess this possibility without making ad-hoc assumptions about differences between programs. In this sense, the case of the green movement in higher education provides a unique opportunity to explore the relationship between emerging fields of study—especially when tied to a social movement—and well-known patterns of gender divisions. The results presented here suggest that change is indeed occurring within these new fields, leading to greater gender equality.

CONCLUSIONS

Most existing theories of gender segregation by field of study focus on explaining the persistence of gender segregation, but are limited in their ability to explain change. This study set out to examine one possible source for changes in gender segregation by fields of study: the curricular offerings in higher education. We argue that new and emerging fields of study can depart from traditional gender divisions and be a force leading to greater equality in higher education. New and emerging fields arrive on the scene with a relatively blank slate with respect to gender norms, allowing them to attract a more balanced population of students to begin with. Therefore, we suggest that far from permanently settled, the distribution of students across fields is highly malleable and subject to change over time. The case of green fields of study is a clear example of these processes in action.

Higher education took substantial steps to respond to the green movement through the creation of new disciplines and programs as well as the expansion of existing ones. Universities are creating new programs and, indeed, entirely new fields of study at an impressive rate. Though the response to changing student demand and broader social currents has taken different forms across institutions, with research universities being fastest to adapt to demand, it nonetheless represents a disruption in the higher education curriculum. Results from the entire population of bachelor's degree recipients in the United States between 2009 and 2013 confirm that green fields of study are indeed more gender balanced and integrated than other fields of study, both within the STEM and non-STEM hemispheres. STEM green fields are more likely to attract women than other STEM fields, and non-STEM green fields are more likely to attract men, converging on gender parity in both cases. We show that these trends are strongest in programs that emerge from fields characterized by high degree of gender imbalance, like engineering, education, and health professions. Moreover, men and women are more equally distributed across programs within green fields than in non-green fields. Together, these results provide compelling evidence that the green movement is an equalizing force in higher education. As the green movement continues to expand in higher education, we are likely to continue to see changes in the direction of gender equality in the distribution of students across fields of study. The implications of these changes for gender segregation in the labor market are still unknown. On the one hand, these trends may help send more educated women to STEM related positions and occupations in the green economy, as well as increase the representation of men in female-dominated occupations like education and psychology. On the other hand, other social mechanisms may continue to separate men and women in the workforce, even given similar education. Future research should take note of these trends, and examine the labor market implications of gender desegregation in green fields of study.

The broader implication of this study is that changing the framing of academic fields can lead to different demographic outcomes. Since the majority of research on gender segregation by fields of study in general—and the underrepresentation of women in science in particular—focuses on micro-level mechanisms, the impact of the organization of higher education is often overlooked. The results presented here indicate that the organization of higher education, at least as it pertains tor curriculum offerings, is consequential for the distribution of students in higher education by gender. We argue that one plausible reason for the more balanced gender distribution we observe in green fields is that they emerge outside of existing gender dichotomies. New fields of study can be framed as both caring and technical, in addition to being both humanistic and scientific (Barone 2011), and through such framing may transcend traditional gender divisions. Moreover, existing frames (i.e., the gender-balanced framing associated with the life sciences) may be adopted by new fields in related disciplines. Cultural definitions of "care" may also shift over time to include a wider set of dimensions. Thus, it is a combination of the newness and framing of green fields of study that likely leads them to attract a more gender-equal distribution of students.

Indeed, changes in the framing of fields have occurred numerous times over the history of American higher education (Geiger 2004). Medicine and law have both been characterized by major demographic changes over the course of the twentieth century, coinciding with curricular changes that deemphasized the technical aspects of their respective task domains. Medical schools slowly emphasized outreach to disadvantaged communities in their curricula throughout the twentieth century (Ludmerer 1999), which coincided with an influx of women and, to a lesser extent, ethnic minorities in the postwar era. Increasing numbers of women admitted to law school, similarly, coincided with changes in the nature of the legal curriculum and perceived career opportunities for attorneys, with women being both pushed and pulled toward emerging specialties that evoke care such as family and environmental law (Abel and Lewis 1995). Thus, the green movement's influence on the curriculum is only one of many case studies in how the normative environment of higher education impacts demographic diversity within fields.

REFERENCES

Abel, Richard and Philip. C. Lewis. 1995. *Lawyers in Society: An Overview*. Berkeley: University of California Press.

Arcidiacono, Peter, V. Joseph Hotz, and Songman Kang. 2012. "Modeling College Major Choices Using Elicited Measures of Expectations and Counterfactuals." *Journal of Econometrics* 166:3-16.

Ayalon, Hanna. 2003. "Women and Men Go to University: Mathematical Background and Gender Differences in Choice of Field in Higher Education." *Sex Roles* 48 (5-6):277-90.

Barone, Carlo. 2011. "Some Things Never Change: Gender Segregation in Higher Education Across Eight Nations and Three Decades." *Sociology of Education* 84(2):157-76.

Berger, Ida. 1997. "The Demographics of Recycling and the Structure of Environmental Behavior." *Environment and Behavior* 29(4):515-31.

Bosso, Chris. 2005. *Environment, Inc: From Grassroots to Beltway*. Lawrence: University Press of Kansas.

Bradley, Karen. 2000. "The Incorporation of Women into Higher Education: Paradoxical Outcomes?" *Sociology of Education* 73:1-18.

Buchmann, Claudia and Tom DiPrete. 2006. "The Growing Female Advantage in College Completion: The Role of Family Background and Academic Achievement." *American Sociological Review* 71(4):515-41.

Carnegie Foundation for the Advancement of Teaching. 2011. *The Carnegie Classification of Institutions of Higher Education*. 2010 ed. Stanford, CA: Carnegie Foundation.

Ceci, Stephen J. and Wendy M. Williams. 2010. *The Mathematics of Sex: How Biology and Society Conspire to Limit Talented Women and Girls*. New York: Oxford University Press.

Charles, Maria and David B. Grusky. 2004. *Occupational Ghettos: The Worldwide Segregation of Women and Men*. Palo Alto, CA: Stanford University Press.

Charles, Maria and Karen Bradley. 2002. "Equal but Separate? A Cross-National Study of Sex Segregation in Higher Education." *American Sociological Review* 67(4):573- 99.

——. 2009. "Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries." *American journal of sociology* 114(4):924-76.

Correll, Shelley J. 2001. "Gender and the Career Choice Process: The Role of Biased Self-Assessments." *American Journal of Sociology* 106(6):1691-1730.

——. 2004. "Constraints into Preferences: Gender, Status and Emerging Career Aspirations." *American Sociological Review* 69: 93-113.

Cortese, Anthony D. 2003. "The Critical Role of Higher Education in Creating a Sustainable Future." *Planning for Higher Education* 31(3):15-22.

Diamantopoulos, Adamantios, Bodo B. Schlegelmilch, Rudolf R Sinkovics, and Greg M. Bohlen. 2003. "Can Socio-Demographics Still Play a Role in Profiling Green Consumers? A Review of the Evidence and an Empirical Investigation." *Journal of Business Research* 56(6):465-80.

Dunlap, Riley E. and Angela G. Mertig. 1991. "The Evolution of the U.S. Environmental Movement from 1970 to 1990: An Overview." *Society & Natural Resources* 4(3):209-18.

Eccles, Jacquelynne S. and Janis E. Jacobs. 1986. "Social Forces Shape Math Attitudes and Performance." *Signs: Journal of Women in Culture and Society* 11(2):367-80.

England, Paula and Su Li 2006. "Desegregation Stalled: The Changing Gender Composition of College Majors." *Gender and Society* 20:657-77.

Frank, David John, Karen Jeong Robinson, and Jared Olesen. 2011. "The Global Expansion of Environmental Education in Universities." *Comparative Education Review* 55(4):546-73.

Frankfurt School of Finance and Management. 2016. "Global Trends in Renewable Energy Investment, 2016." Retrieved May 23, 2017 (http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf).

Geiger, Roger L. 2004. *Research and Relevant Knowledge: American Research Universities Since World War II*. New Brunswick, NJ: Transaction Publishers.

Gerber, Theodore P. and Sin Yi Cheung. 2008. "Horizontal Stratification in Postsecondary Education: Forms, Explanations, and Implications." *Annual Review of Sociology* 34:299-318.

Haanpää, Lenna. 2007. "Consumers' Green Commitment: Indication of a Postmodern Lifestyle?" *International Journal of Consumer Studies* 31(5):478-86.

Jacobs, Jerry A. 1995. "Gender and Academic Specialties." *Sociology of Education* 68(2):81-98.

——. 1996. "Gender Inequality and Higher Education." *Annual Review of Sociology* 22:153-85.

Jonsson, Jan. 1999. "Explaining Sex Differences in Educational Choice: An Empirical Assessment of a Rational Choice Model." *European Sociological Review* 15(4):391-404.

Kerr, Clark. 2001. *The Uses of the University*. 5th ed. Cambridge, MA: Harvard University Press.

Kolk, Ans. 2004. "A Decade of Sustainability Reporting: Developments and Significance." *International Journal of Sustainable Development* 3(1):51-64.

Kraatz, Matthew and Edward Zajac. 1996. "Exploring the Limits of the New Institutionalism: The Causes and Consequences of Illegitimate Organizational Change." *American Sociological Review* 61:812-36.

Luchs, Michael G. and Todd A. Mooradian. 2012. "Sex, Personality, and Sustainable Consumer Behaviour: Elucidating the Gender Effect." *Journal of Consumer Policy* 35(1):127-44.

Ludmerer, Meyer. 1999. *Time to Heal: American Medical Education from the Turn of the Century to the Era of Managed Care*. New York: Oxford University Press.

Mann, Allison and Thomas A. DiPrete. Forthcoming. "Trends in Gender Segregation in the Choice of Science and Engineering Majors." *Social Science Research*.

Margolis, Jane, Rachel Estrella, Joanna Goode, Jennifer Holme, and Kim Nao. 2008. *Stuck in the Shallow End: Education, Race, and Computing*. Cambridge, MA: The MIT Press.

Morgan, Carolyn Stout. 1992. "College Students' Perceptions of Barriers to Women in Science and Engineering." *Youth & Society* 24(2):228-36.

Morgan, Stephen, Dafna Gelbgiser, and Kim Weeden. 2013. "Feeding the Pipeline: Gender, Occupational Plans, and College Major Selection." *Social Science Research* 42(2):989-1005.

National Center for Education Statistics, U.S. Department of Education. 1998-2010. "Institutional Characteristics." Retrieved March 10, 2013 ((http://nces.ed.gov/ipeds/datacenter/).

Olzak, Susan and Nicole Kangas. 2008. "Organizational Innovation: Establishing Racial, Ethnic, and Women's Studies Programs in the U.S." *Sociology of Education* 81:163-88.

Pfeffer, Jared and Gerald R. Salancik. 1978. *The External Control of Organizations: A Resource Dependence Perspective*. New York: Harper & Row.

Porter, Stephen R. and Paul D. Umbach 2006. "College Major Choice: An Analysis of Person-Environment Fit." *Research in Higher Education* 47(4):429-49.

Ramirez, Francisco and Christine Wotipka. 2001. "Slowly but Surely? The Global Expansion of Women's Participation in Science and Engineering Fields of Study, 1972-92." *Sociology of Education* 74(3):231-51.

Ridgeway, Cecilia. 2011. *Framed by Gender: How Gender Inequality Persists in Modern America*. New York: Oxford University Press.

Rondinelli, Dennis and Gyula Vastag 2000. "Panacea, Common Sense, or Just a Label? The Value of ISO 14001 Environmental Management Systems." *European Management Journal* 18(5):499-510.

Scott, W. Richard. 1995. *Institutions and Organizations: Ideas, Interests, and Identities*. Thousand Oaks, CA: Sage Publications.

Selznick, Philip. 1957. *Leadership in Administration: A Sociological Interpretation.* Berkeley: University of California Press.

Seymour, Elaine and Nancy M. Hewett. 1998. *Talking About Leaving: Why Undergraduates Leave the Sciences*. Boulder, CO: Westview Press.

Simpson, Jacqueline C. 2001. "Segregation by Subject: Racial Differences in the Factors Influencing Academic Major Between European American, Asian American and African, Hispanic and Native Americans." *Journal of Higher Education* 72:63-100.

Steele, Claude M. and Joshua Aronson. 1995. "Stereotype Threat and the Intellectual Test Performance of African Americans." *Journal of Personality and Social Psychology.* 69(5):797-811.

Steele, Jennifer, Jacquelyn B. James, and Rosalind C. Barnett. 2002. "Learning in a Man's World: Examining the Perceptions of Undergraduate Women in Male-Dominated Academic Areas." *Psychology of Women Quarterly* 26(1):46-50.

Strietska-Ilina, Olga, Christine Hofmann, Mercedes Duran Haro, and Shinyoung Jeon. 2011. *Skills for Green Jobs: A Global View*. Geneva, Switzerland: International Labour Organization.

Tolbert, Pamela S. and Lynne G. Zucker. 1983. "Institutional Sources of Change in the Formal Structure of Organizations: The Diffusion of Civil Service Reform, 1880-1930." *Administrative Sciences Quarterly* 28:22-39.

Turner, Sarah E. and William G. Bowen. 1999. "Choice of College Major: The Changing (Unchanging) Gender Gap." *Industrial and Labor Relations Review* 52(2):289-313.

U.S. Department of Education. 2010. "Classification of Instructional Programs." Retrieved September 8, 2014 (http://nces.ed.gov/ipeds/cipcode/resources.aspx?y=55).

——. 2011. "Postsecondary Awards in Science, Technology, Engineering and Mathematics, By State: 2001 and 2009." Retrieved November 19, 2013 (http://nces.ed.gov/pubs2011/2011226.pdf).

U.S. Economics and Statistics Administration. 2010. "Measuring the Green Economy." Retrieved April 6, 2017 (from www.esa.doc.gov/Reports/measuring-green-economy).

——. 2012. "Women in STEM: A Gender Gap to Innovation." Retrieved March 30, 2013 (www.esa.doc.gov/sites/default/files/reports/documents/womeninstemagaptoinnovation8311.pdf).

U.S. National Science Foundation. 2005. "NSF STEM Classification of Instructional Programs Crosswalk." Retrieved September 8, 2014 (www.temple.edu/vpus/amp/documents/NSF_STEM_Classifications06.pdf).

Wolf, Johanna and Susan Moser. 2011. "Individual Understandings, Perceptions, and Engagement with Climate Change: Insights from In-Depth Studies Across the World." *Wiley Interdisciplinary Reviews: Climate Change* 2(4):547-69.

Wright, Tarah. 2010. "University Presidents' Conceptualizations of Sustainability in Higher Education." *International Journal of Sustainability in Higher Education* 11(1):61-73.

Xie, Yu and Kimberlee. A. Shauman. 2003. *Women in Science: Career Processes and Outcomes*. Cambridge, MA: Harvard University Press.