emeraldinsight

Equality, Diversity and Inclusion: An International Journal

NSF ADVANCE and gender equity: Past, present and future of systemic institutional transformation strategies

Jessie DeAro, Sharon Bird, Shermaine Mitchell Ryan,

Article information:

To cite this document:
Jessie DeAro, Sharon Bird, Shermaine Mitchell Ryan, (2019) "NSF ADVANCE and gender equity: Past, present and future of systemic institutional transformation strategies", Equality, Diversity and Inclusion: An International Journal, Vol. 38 Issue: 2, pp.131-139, https://doi.org/10.1108/EDI-09-2017-0188
Permanent link to this document:
https://doi.org/10.1108/EDI-09-2017-0188

Downloaded on: 07 March 2019, At: 07:46 (PT)
References: this document contains references to 59 other documents.
To copy this document: permissions@emeraldinsight.com
The fulltext of this document has been downloaded 10 times since 2019*

Users who downloaded this article also downloaded:

(2019),"ADVANCEing women faculty in STEM: empirical findings and practical recommendations from National Science Foundation ADVANCE institutions", Equality, Diversity and Inclusion: An International Journal, Vol. 38 Iss 2 pp. 122-130 https://doi.org/10.1108/EDI-03-2019-295

Access to this document was granted through an Emerald subscription provided by All users group

For Authors

If you would like to write for this, or any other Emerald publication, then please use our Emerald for Authors service information about how to choose which publication to write for and submission guidelines are available for all. Please visit www.emeraldinsight.com/authors for more information.

About Emerald www.emeraldinsight.com

Emerald is a global publisher linking research and practice to the benefit of society. The company manages a portfolio of more than 290 journals and over 2,350 books and book series volumes, as well as providing an extensive range of online products and additional customer resources and services.

Emerald is both COUNTER 4 and TRANSFER compliant. The organization is a partner of the Committee on Publication Ethics (COPE) and also works with Portico and the LOCKSS initiative for digital archive preservation.

*Related content and download information correct at time of download.

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

The current issue and full text archive of this journal is available on Emerald Insight at:
www.emeraldinsight.com/2040-7149.htm

NSF ADVANCE and gender equity

Past, present and future of systemic institutional transformation strategies

Jessie DeAro
Directorate for Education and Human Resources, National Science Foundation, Alexandria, Virginia, USA
Sharon Bird
Department of Sociology, Oklahoma State University, Stillwater, Oklahoma, USA, and
Shermaine Mitchell Ryan
Health and Environment Sciences Institute, Washington, District of Columbia, USA

Received 15 September 2017
Revised 15 February 2018
15 November 2018
23 January 2019
Accepted 23 January 2019

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

Abstract

Purpose – Supporting the advancement of science, technology, engineering and mathematics (STEM) in ways that help to ensure the health, prosperity, welfare and security of the nation has been central to the mission of the US National Science Foundation (NSF) since 1950, the year Congress created the agency. Preparing a highly qualified and diverse STEM workforce plays a central role in supporting this mission. The paper aims to discuss these issues.

Design/methodology/approach – Over the past several decades, many positive steps have been taken throughout the US education system to help ensure a more diverse STEM workforce. Even so, women remain underrepresented among STEM faculty in higher education, especially at the upper ranks. Contributing to women's underrepresentation are systemic obstacles to the recruitment, retention and promotion of women of different racial, ethnic, disability, sexual orientations and nationality statuses.

Findings – The NSF ADVANCE Program is designed to address these barriers. Success for ADVANCE is, therefore, best defined in terms of the changes made to the structures and climates of academic workplaces, rather than in numbers of women hired, retained or promoted in any one institution at a given point in time.

Originality/value – This introduction briefly examines the origins of ADVANCE, key transitions in the program over time, its reach nationally and internationally, and its future.

Keywords Gender, Equity, Organizational change, STEM faculty, Culture and climate, Systemic change

Paper type General review

National Science Foundation (NSF) ADVANCE: origins

The NSF ADVANCE program, which was developed under the leadership of the NSF Office of the Director and with the support of a design committee comprised of representatives from each of the seven NSF Directorates, issued the first call for ADVANCE proposals in 2001 (www.nsf.gov/crssprgm/advance/implementation.jsp). Recognizing the need for ensuring attention to gender equity in each STEM discipline, the ADVANCE Implementation Committee (AIC) was also created in 2001 to work with the ADVANCE program officer to implement the NSF-wide program. The first call for proposals included tracks for fellowship, leadership and institutional transformation (IT) proposals (NSF, 2001). Of these three tracks, the IT track with its focus on systemic change within US institutions of higher education (IHEs) represented a new NSF program model for broadening the participation of underrepresented groups in STEM. IHEs seeking ADVANCE IT awards were required to develop strategies for reducing institutionalized gender inequities.

Any opinions, findings, conclusions or recommendations presented are only those of the authors and do not necessarily reflect the views of the National Science Foundation.

Equality, Diversity and Inclusion: An International Journal
Vol. 38 No. 2, 2019
pp. 131-139
© Emerald Publishing Limited
2040-7149
DOI 10.1108/EDI-09-2017-0188

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

Multiple factors contributed to the initial focus on supporting systemic change. Among these was the 1999 Massachusetts Institution of Technology (MIT) report which found that systemic inequities were negatively affecting female faculty's compensation and resources and a related report by the leadership of nine prestigious research universities (Campbell, 2001; LaVaque-Manty, 2010; Massachusetts Institute of Technology Committee on Women Faculty, 1999; Vest *et al.*, 1999). Other contributors included recommendations to NSF from researchers studying gender and STEM, data from recipients of NSF grants to women, and over two decades of research pointing to institutionalized inequities, cultural barriers and implicit biases built into organizations in the form of policies, work arrangements, and routinized practices (e.g. Acker, 1990; Britton, 2001; Collins, 2000; Crenshaw, 1995; Foschi, 1996; Kanter, 1977; Long and Fox, 1995; Massachusetts Institute of Technology Committee on Women Faculty, 1999; Reskin, 1978; Rosser, 1995; Rosser, 2004; Rosser, 2017; Steinpreis *et al.*, 1999; Valian, 1998; Xie and Shauman, 2003). Foundational knowledge about institutional inequities has grown with each new ADVANCE IT cohort, revealing the complexity of systemic barriers to equity and the need for more innovative change strategies (e.g. Bystydzienski and Bird, 2006; Mason and Goulden, 2002; Morimoto and Zajicek, 2014; National Academy of Sciences, 2006; Stewart *et al.*, 2007; Sturm, 2006).

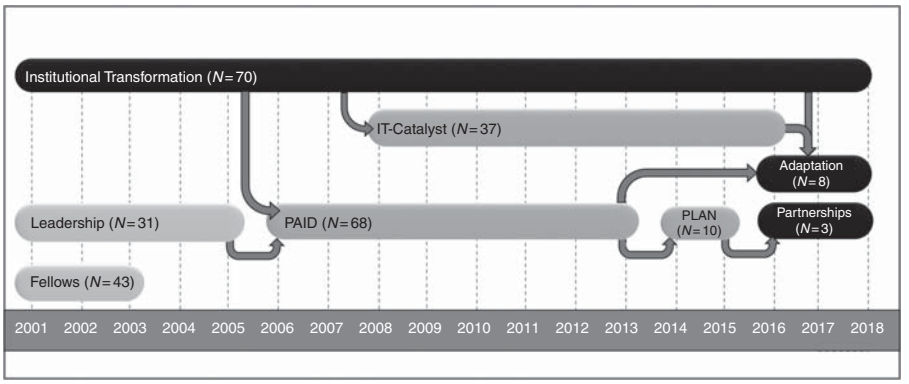
The ADVANCE program's focus on gender, systemic barriers to equity and the STEM academic workforce, vs diversity in general and the broader STEM workforce or the STEM "pipeline" was unique among other broadening participation NSF grant programs. This focus has facilitated the accumulation of knowledge, the translation of that knowledge into actionable change efforts and dissemination of change strategies across IHEs. The focus on STEM faculty is also strategic given the crucial roles STEM faculty have in mentoring undergraduate and graduate students and postdoctoral trainees, developing research questions and methods, communicating science to the public and guiding the national STEM research agenda.

NSF ADVANCE: program portfolio and transitions

Looking back over the past decade and a half of NSF ADVANCE, important transitions have occurred to the program design. In the early years of ADVANCE, aspects of previous models that focused on providing STEM research support to individual researchers were still evident in the fellowship and leadership tracks. Although these "grants [made to individual women] were often powerfully effective for those individuals, the environment those people worked in was not changing and often did not support their success" (Alice Hogan, former ADVANCE Program Officer, cited in LaVaque-Manty, 2010, p. 22). Reports to NSF pointing to the feasibility, impact, sustainability and scalability of systemic change efforts from the first 19 IT institutions and NSF site visits during this time helped move the NSF ADVANCE program even more toward institutional and systemic change. Figure 1 provides a timeline for the different tracks of the NSF ADVANCE program and the total number of awards in each track.

The IT track has been a part of ADVANCE since 2001. As of fall 2018, there are 70 ADVANCE IT institutions (including alumni ITs) nationwide. Recent IT projects have extended earlier ADVANCE research by illuminating the complexities of intersectionality, or the interconnectedness of multiple structures of social inclusion and exclusion, and add to our understanding of why increasingly sophisticated strategies are required to address intersectional inequities (Armstrong and Jovanovic, 2017; Hunt *et al.*, 2012). Other recent studies reveal, for example, the complexities associated with how gender, intersectionality, faculty service workloads, work–life balance and department culture affect faculty advancement (e.g. Campbell and O'Meara, 2014; Jackson *et al.*, 2017). Others build on research about microaggressions in the academic workplace to examine how bystanders can best address these infractions (e.g. Banyard *et al.*, 2015).

Scholars studying the IT cohorts have published numerous journal articles and books focusing on institutional change efforts (Branch, 2016; Bilimoria and Liang, 2012; Fox, 2008;



Notes: *N* = the number of awards (the number of institutions and organizations is larger due to partnerships). Competitions for each track were held every other year. The arrows indicate where lessons learned from the different tracks informed the focus and design of later tracks

Figure 1. The timeline of NSF ADVANCE program tracks

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

Laursen and Rocque, 2010; Rosser and Chameau, 2006; Stewart *et al.*, 2007). Analyses based on ADVANCE IT cohorts have also resulted in the syntheses of systemic change strategies such as the StratEGIC Toolkit website (Laursen and Austin, 2014).

The ADVANCE literature to date has often focused on the first two cohorts of IT grantees. Researchers investigating the impacts of these projects should keep in mind that these early grants were likely impacted by a 20 percent minimum cost share requirement for IT projects (NSF, 2001), which resulted in an average award of $4.3m for each five-year project. Later IT cohorts did not have the cost share requirement due to changes in the NSF cost sharing policies (National Science Board, 2004). The ADVANCE IT awards following these changes averaged $3.3m for each five-year project, suggesting significant differences in scope between these IT project cohorts.

We now turn our attention to the other ADVANCE tracks, especially those that represent important efforts by NSF to diversify the types of IHEs participating in the ADVANCE program, and to scale-up and disseminate promising systemic change strategies. About one-third of the total ADVANCE investment since 2001 has supported efforts to scale-up and disseminate systemic change strategies.

The NSF ADVANCE program introduced Partnership proposals in 2006 to adapt promising IT strategies to new contexts, support national STEM discipline-specific projects, and to include non-profit organizations. Between 2006 and 2018, 88 IHEs and 11 non-profit STEM organizations were involved in Partnership awards made under the "Partnerships for Adaptation, Implementation and Dissemination," "Partnerships for Learning and Adaptation Networks" and Partnerships tracks. The Partnership awardees include 19 prior IT awardees that proposed to facilitate the adaptation of IT strategies by other institutions and stakeholders, thereby extending the reach of the original ADVANCE investments. In total, Partnership awards supported the adaptation of promising IT strategies to 43 IHEs. One early example is the 2008 collaboration between Skidmore College and Union College, which focused on implicit bias training for faculty, administrators and students, and on addressing related issues including promotion from associate to full professor. This collaboration built on the innovations of earlier IT grantees, including Virginia Tech, University of Wisconsin–Madison and University of Michigan Ann Arbor (NSF award No. 0820080; http://sun.skidmore.union.edu/index.html). The Partnership portfolio also includes non-academic organizations such as professional societies because of their influence on the culture and climate of STEM disciplines and the academic workforce. For example, the Association for Women in Science's (AWIS)

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

work with the leadership of 18 other scientific societies sought to enhance the transparency of STEM awards and recognition processes, and to implement best practices for increasing gender equity (NSF award No. 0930073; Cadwalader *et al.*, 2014).

To further diversify the types of institutions participating in the ADVANCE program, the IT-Catalyst track (previously "IT-Start") was added in 2008. Between 2008 and 2016, the IT-Catalyst track supported 37 institutions with grants ($200,000–300,000) to undertake institutional self-assessments focusing on gender equity for faculty and to pilot organizational change strategies. The IT-Catalyst track helped diversify the types of institutions participating in the ADVANCE program with 40 percent of IT-Catalyst awards going to minority-serving institutions and over 50 percent to predominantly undergraduate institutions, including the program's first community colleges: Brunswick Community College (NSF award No. 1008660) and Ivy Technical Community College (NSF award No. 1209019). The success of the Partnerships projects to adapt promising IT strategies led to the Adaptation track, which enables IHEs and non-profit organizations to adapt and implement promising IT strategies without the expectation for innovating systemic change strategies or for original research on gender equity in STEM academics, both of which were required as a part of the IT projects.

The 2019 ADVANCE solicitation has four program tracks, all of which focus on systemic institutional change strategies: Institutional Transformation, Catalyst, Adaptation and Partnerships (NSF, 2019). Expectations that all ADVANCE proposals include an intersectional perspective began in the 2016 ADVANCE solicitation (NSF, 2016) and continues in the 2019 ADVANCE solicitation (NSF, 2019). The focus on intersectionality was informed by ADVANCE grantee research and related research on the complexity of barriers to equity confronted by STEM faculty of different social identities – including gender, race, ability/disability, ethnicity, sexual orientation and nationality (e.g. Armstrong and Jovanovic, 2015; Branch, 2013; Brown, 2000; Browne and Misra, 2003; Burrelli, 2009; Caroline and Johnson, 2007; Malcom *et al.*, 1976; Malcom and Malcom-Piquex, 2013; Morimoto and Zajicek, 2014; Ong, 2011; Ong *et al.*, 2011, 2016; Wu and Jing, 2011).

NSF ADVANCE: program reach

The $315m NSF investment in ADVANCE between 2001 and 2018 equates to approximately 0.27 percent of the total NSF budget during this time. This investment has directly reached 177 different IHEs with an NSF ADVANCE grant of some type (i.e. about 5.3 percent of all non-profit US IHEs). Publications by ADVANCE institutions, which commonly center on the changes in academic workplace policies and procedures, have examined topics including faculty recruitment and hiring practices, work–life balance programs, mentoring programs, and promotion and tenure policies. This body of research indicates that institutional changes in policies, practices, and cultures are associated with increases in institutions' collection and use of faculty data, changes in policies that affect how hiring processes are carried out, new mentoring and work–life balance programs, and changes in how promotion and tenure processes are conducted. Systemic institutional changes are, in turn, linked to increases in faculty job satisfaction and commitment, and over the long term the numbers of faculty hired and retained who are women (e.g. Callister, 2006; Rosser and Chameau, 2006; Bilimoria *et al.*, 2008; Lundquist *et al.*, 2012; Mason *et al.*, 2013; Settles *et al.*, 2006; Smith *et al.*, 2015).

The reach of the ADVANCE program extends beyond the program's direct grantees. Dissemination of ADVANCE strategies occurs through grantee research publications and presentations, and through the purposeful dissemination of practices by ADVANCE grantees. Among the ADVANCE program's most significant outcomes are the organizational change models that have been developed, studied and improved by ADVANCE grantees and then adapted by others with and without NSF funds. One early example is the Strategies and Tactics for Recruiting to Improve Diversity and Excellence (STRIDE) committee developed under the University of Michigan at Ann Arbor's ADVANCE *IT* project (NSF award No. 0123571).

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

The STRIDE model has been adapted by numerous US and international academic institutions, companies, professional societies and US national research laboratories (http://advance.umich.edu/strideCommittee.php). Another promising strategy is the "Advocates and Allies" model based on earlier "equity advisor" models and further developed by the North Dakota State University to recruit male STEM faculty to become allies in the effort to enhance gender equity in STEM (NSF award no. 0811239 and no. 1500604). The spread of ADVANCE strategies, furthermore, has resulted from the mobility of ADVANCE leaders. Over 400 faculty and administrators have served as ADVANCE principle and co-principle investigators and thousands more faculty and administrators participated in ADVANCE activities since 2001. Many of these people have taken ADVANCE-developed strategies and tools with them as they move from ADVANCE institutions to new positions. Dr Luis Falcón, who is now Dean of Fine Arts, Humanities and Social Sciences at the University of Massachusetts–Lowell, conveys one of the many examples of ADVANCE diffusion. Previously, as Vice-Provost for Graduate Education at Northeastern University, Dr Falcón was a co-PI on NU's 2008 ADVANCE IT project (NSF award no. 0811170). Because NU ADVANCE had adapted the Michigan STRIDE model, Dr Falcón had also trained as a STRIDE facilitator. Then, when he moved to the University of Massachusetts–Lowell as a Dean in 2012, Dr Falcón incorporated STRIDE principles and strategies developed by ADVANCE institutions to enhance applicant, interviewee and candidate diversity in hiring processes in his college. These activities were later implemented and expanded across the institution, including to non-STEM colleges without NSF funds. These efforts helped position UMASS Lowell to be more competitive for and receive an ADVANCE IT grant in 2016 to advance additional innovative systemic change strategies (NSF award no. 1629761) (personal communication with Dr Luis Falcón, January 2018; www.uml.edu/Research/ADVANCE).

Another example comes from Dr Theresa Lee who was a Department Chair at the University of Michigan Ann Arbor before moving to the University of Tennessee at Knoxville (UTK) in 2012 to become the Dean of the College of Arts and Sciences. When Dr Lee arrived, she worked with the Provost to support and encourage senior STEM faculty to create their own version of a STRIDE committee. Three UTK faculty members participated in the 2013 "Strategies Toward Excellent Practices (STEP) in Departments" workshop at Michigan (originally supported by ADVANCE Partnership NSF award no. 0620022). The UTK STRIDE committee began soon thereafter, implementing training for search committees. Through the STRIDE committee and with funding from the Office of the Provost, UTK continues to provide search committee training and workshops on retention, inclusion, and departmental climate (https://stride.utk.edu/, personal communication with Dr Soren Sorensen, January 2018). These efforts helped position UTK for an NSF ADVANCE Adaptation award (NSF award no. 1760382) under the leadership of Materials Science and Engineering Professor and Department Head, Dr Veerle Keppens (https://news.utk.edu/2018/08/30/nsf-funds-project-to-help-ut-recruit-retain-female-faculty-in-stem/).

The sustainability of ADVANCE IT initiatives depends on the extent to which institutions and organizations establish and sustain structures and cultures conducive to their ADVANCE equity-enhancement efforts. Examination of ADVANCE IT websites conducted by NSF ADVANCE program personnel revealed approximately two-thirds of these institutions continue to support and promote ADVANCE activities. These activities are often housed in "ADVANCE" or other institutional offices (e.g. Diversity and Inclusion, Faculty Affairs or Faculty Development and Success offices, Women in Science programs). Institutional ADVANCE activities have often expanded to include more than gender and more than just STEM departments and faculty. The University of California at Irvine, one of the first IT awardees, institutionalized UCI ADVANCE in 2006 and expanded the Office of Inclusive Excellence's scope to include race, ethnicity, disability, in addition to gender but maintains a focus on faculty issues (https://inclusion.uci.edu/advance/about-us/).

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

Another institution with more than a decade of sustained ADVANCE work is the University of Wisconsin–Madison's Women in Science and Engineering Leadership Institute, a research center that leads ADVANCE activities on campus, nationally and internationally (http://wiseli.engr.wisc.edu/).

The NSF ADVANCE program, in addition to its national impact, serves as a model for equity internationally. Governing bodies and research organizations across the globe recognize NSF ADVANCE. A European Commission report by the Expert Group on Structural Change notes, for example, that "the US has led the way with the ADVANCE programme [sic]" in funding initiatives to address "the structural barriers contributing to the well-known leaky pipeline phenomenon," and that these efforts have "led to a shift in focus towards addressing the structural transformation of institutions, using a systemic, comprehensive and sustainable approach" (European Commission, 2012, p. 6). As noted in the 2012 "Equality and Status of Women in Research" report, the Global Research Council, comprised of the heads of national STEM funding agencies from around the world, recognized NSF ADVANCE's unique "approach to encouraging gender equality in research" and its focus on "culture change in RPOs [Research Performing Organizations] through institutional transformation grants" (Metcalfe and Day, 2016, p. 13). The same report recognizes the prestige that ADVANCE awards bring to US IHEs, and explains that the "European H2020 funding for INTEGER [Institutional Tranformation for Effecting Gender Equality in Research] is modelled on the ADVANCE program" (Metcalfe and Day, 2016, p. 13).

NSF ADVANCE: the future

One goal for the future is to facilitate the dissemination and translation of ADVANCE strategies to more stakeholders and organizations. ADVANCE grantees have produced over 200 peer-reviewed journal publications and conference proceedings and at least 28 books or book chapters on systemic change and gender equity in STEM academia. In addition, toolkits, presentations and training materials are available on grantee websites for download and use by others. To capitalize on the potential value of these resources and knowledge, the NSF ADVANCE program awarded a five-year grant to AWIS in 2017 to launch an ADVANCE Resource Coordination (ARC) Network (NSF award no. 1740860). The ARC Network "strives to advance STEM equity in academia" by cultivating collaborations among diverse audiences and sharing evidence-based best practices for affecting change in STEM workplaces (www.equityinstem.org/about/). Also promising for the future are new systemic change projects such as the STEM Equity Achievement (SEA Change) initiative led by the American Association for the Advancement of Science. The SEA Change project, which was catalyzed with NSF ADVANCE workshop support in 2016, seeks to appraise the "[s]ystematic transformation efforts of participating institutions" and "as part of the [SEA Change] assessment" to award "bronze, silver or gold ratings for their efforts" to these IHEs (www.aaas.org/news/sea-change-program-aims-transform-diversity-efforts-stem).

Whether or not the ADVANCE program will be in place for another 18 years is yet to be determined. One positive sign is the February 2019 release of a new NSF ADVANCE solicitation (NSF 19-552) calling for new proposals in fiscal years 2019 and 2020. If the ADVANCE program is sustained in the long term, there is no doubt that it would continue to learn from its past investments and make changes to the program as necessary to address emerging issues, new research, and changing contexts. According to the new solicitation, the future for ADVANCE, at least in the short term, will include more partnerships between IHEs and organizations to scale up and diffuse promising practices, and more discipline specific ADVANCE projects to address the uniqueness of STEM disciplinary cultures and the varying representation of women in each STEM discipline. Given the success of NSF ADVANCE in the first 18 years, prospects are bright. ADVANCE has demonstrated that a

relatively modest federal grant program can contribute important new knowledge and strategies to address systemic barriers to broadening participation in the STEM academic workforce.

References

Acker, J. (1990), "Hierarchies, jobs, and bodies: a theory of gendered organizations", *Gender and Society*, Vol. 4 No. 2, pp. 139-158.

Armstrong, M.A. and Jovanovic, J. (2015), "Starting at the crossroads: intersectional approaches to institutionally supporting underrepresented minority women STEM faculty", *Journal of Women and Minorities in Science and Engineering*, Vol. 21 No. 2, pp. 141-157.

Armstrong, M.A. and Jovanovic, J. (2017), "The intersectional matrix: rethinking institutional change for URM women in STEM", *Journal of Diversity in Higher Education*, Vol. 10 No. 3, pp. 216-231.

Banyard, V., Shea, C. and Jha, Y. (2015), "Bystanders in the academic workplace: Theoretical model and preliminary results", poster presented at the AWIS NSF ADVANCE Workshop, Baltimore, MD.

Bilimoria, D. and Liang, X. (2012), *Gender Equity in Science and Engineering: Advancing Change in Higher Education*, Routledge, New York, NY.

Bilimoria, D., Joy, S. and Liang, X. (2008), "Breaking barriers and creating inclusiveness: lessons of organizational transformation to advance women faculty in academic science and engineering", *Human Resource Management*, Vol. 47 No. 3, pp. 423-441.

Branch, E.H. (2013), "A road instead of a pipeline? Incorporating agency and constraint into our understanding of women in science", paper presented at the Women in Science Mini-Conference at the Eastern Sociological Society Meeting, March 23, Boston, MA.

Branch, E.H. (Ed.) (2016), *Pathways, Potholes and the Persistence of Women in Science: Reconsidering the Pipeline*, Lexington Books, New York, NY.

Britton, D.M. (2001), "The epistemology of the gendered organization", *Gender and Society*, Vol. 14 No. 3, pp. 418-434.

Brown, S.V. (2000), "The preparation of minorities for academic careers in science and engineering: how well are we doing?", in Campbell, G., Denes, R. and Morrison, C. (Eds), *Access Denied: Race, Ethnicity, and the Scientific Enterprise*: Oxford University Press, New York, NY, pp. 239-269.

Browne, I. and Misra, J. (2003), "The intersection of gender and race in the labor market", *Annual Review of Sociology*, Vol. 29, pp. 487-513.

Burrelli, J. (2009), "Women of color in stem education and employment", paper presented at the Mini-Symposium on Women of Color in STEM, October 27, Arlington, VA.

Bystydzienski, J. and Bird, S.R. (Eds) (2006), *Removing Barriers: Women in Academic Science, Engineering, Technology and Mathematics Careers.*, Indiana University Press, Bloomington, IN.

Cadwalader, E.L., Herbers, J.M. and Popejoy, A.B. (2014), "Professional societies and gender equity in STEM", in Bilimoria, D. and Lord, L. (Eds), *Women in STEM Careers: International Perspectives on Increasing Workforce Participation, Advancement and Leadership*, Edward Elgar Publishing, Northampton, MA, pp. 166-185.

Callister, R.R. (2006), "The impact of gender and department climate on job satisfaction and intentions to quit for faculty in science and engineering fields", *Journal of Technology Transfer*, Vol. 31, pp. 367-375.

Campbell, C.M. and O'Meara, K. (2014), "Faculty agency: departmental contests that matter in faculty careers", *Research in Higher Education*, Vol. 55 No. 1, pp. 49-74.

Campbell, K. (2001), "Universities issue statement on equity for women faculty", MIT News Office, available at: http://news.mit.edu/2001/gender-0131 (accessed September 9, 2016).

Caroline, H.B. and Johnson, A. (2007), "Understanding the science experiences of successful women of color: science identity as an analytic lens", *Journal of Research in Science Teaching*, Vol. 44 No. 8, pp. 605-619.

Collins, P.H. (2000), *Black Feminist thought: Knowledge, Consciousness and the Politics of Empowerment*, 2nd ed., Routledge, New York, NY.

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)

Crenshaw, K.W. (1995), "Mapping the margins: intersectionality, identity politics, and violence against women of color", in Crenshaw, K., Gotanda, N., Peller, G. and Thomas, K. (Eds), *Critical Race Theory: The Key Writings that Formed the Movement*, New Press, New York, NY, pp. 357-383.

European Commission (2012), *Structural Change in Research Institutions: Enhancing Excellence, Gender Equality and Efficiency in Research and Innovation*, Publications Office of the European Union, Luxembourg, doi: 10.2777/32045.

Foschi, M. (1996), "Double standards in the evaluation of men and women", *Social Psychology Quarterly*, Vol. 59 No. 3, pp. 237-254.

Fox, M. (2008), "Institutional transformation and the advancement of women faculty: the case of academic science and engineering", in Smart, J. (Ed), *Higher Education: Handbook of Theory and Research*, Vol. XXIII, Springer, New York, NY, pp. 73-103.

Hunt, V.H., Morimoto, S., Zajicek, A. and Lisnic, R. (2012), "Intersectionality and dismantling institutional privilege: the case of the NSF ADVANCE program", *Race, Gender and Class*, Vol. 19, Nos 1-2 pp. 266-290.

Jackson, K.J., Latimer, M. and Stoiko, R. (2017), "The dynamic between knowledge production and faculty evaluation: perceptions of the promotion and tenure process across disciplines", *Innovative Higher Education*, Vol. 42 No. 3, pp. 193-205.

Kanter, R. (1977), *Men and Women of the Corporation*, Basic Books, New York, NY.

Laursen, S. and Rocque, B. (2010), "Faculty development for institutional change: lessons from an advance project", *Change: The Magazine of Higher Learning*, Vol. 41 No. 2, pp. 18-26.

Laursen, S.L. and Austin, A.E. (2014), "StratEGIC toolkit: strategies for effecting gender equity and institutional change.available at: www.strategictoolkit.org (accessed July 28, 2016).

LaVaque-Manty, D. (2010), "Transforming the scientific enterprise: an interview with Alice Hogan", in Stewart, A.J., Malley, J.E. and LaVaue-Manty, D. (Eds), *Transforming Science and Engineering: Advancing Academic Women*, University of Michigan Press, Ann Arbor, MI, pp. 21-27.

Long, S.J. and Fox, M.F. (1995), "Scientific careers: universalism and particularism", *Annual Review of Sociology*, Vol. 21, No. 3 pp. 45-71.

Lundquist, J.H., Misra, J. and O'Meara, K. (2012), "Parental leave usage by fathers and mothers at an American university", *Fathering*, Vol. 10, No. 3 pp. 337-363.

Malcom, S.M. and Malcom-Piquex, L.E. (2013), "Critical mass revisited: learning lessons from research on diversity in STEM fields", *Educational Researcher*, Vol. 42 No. 3, pp. 176-178.

Malcom, S.M., Hall, P. and Brown, J. (1976), *The Double Bind: The Price of Being a Minority Woman in Science*, American Association for the Advance of Science, Washington, DC.

Mason, M.A. and Goulden, M. (2002), "Do babies matter? The effect of family formation on the lifelong careers of academic men and women", *Academe*, Vol. 88 No. 6, pp. 21-27.

Mason, M.A., Wolfinger, N.H. and Goulden, M. (2013), *Do Babies Matter? Gender and Family in the Ivory Tower*, Rutgers University Press, New Brunswick, NJ.

Massachusetts Institute of Technology Committee on Women Faculty (1999), *A Study of the Status of Women Faculty in Science at MIT*, Cambridge, MA, available at: http://web.mit.edu/fnl/women/women.html (accessed July 28, 2016).

Metcalfe, J. and Day, E. (2016), "Equality and status of women in research: survey report for the GRC 2016 annual meeting", The Careers Research and Advisory Centre (CRAC) Limited, available at: www.globalresearchcouncil.org/fileadmin//documents/GRC_Publications/Survey_Report_on_Equality_for_GRC_Vitae.pdf.

Morimoto, S.A. and Zajicek, A. (2014), "Dismantling the 'master's house': feminist reflections on institutional transformation", *Critical Sociology*, Vol. 40 No. 1, pp. 135-150.

National Academy of Sciences (2006), *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, National Academies Press, Washington, DC.

National Science Board (2004), "Memorandum to members and consultants of the National Science Board", NSB-04-157, available at: www.nsf.gov/nsb/meetings/2004/1004/major_action_1004.pdf

National Science Foundation (NSF) (2001), "ADVANCE increasing the participation and advancement of women in academic science and engineering careers", NSF 01-69, Arlington, VA.

National Science Foundation (NSF) (2016), "ADVANCE: increasing the participation and advancement of women in academic science and engineering careers", NSF 16-694, Arlington, VA.

National Science Foundation (NSF) (2019), "ADVANCE: organizational change for gender equity in STEM academic professions", NSF 19-552, Alexandria, VA.

Ong, M. (2011), "The status of women of color in computer science", *Communications of the ACM*, Vol. 54 No. 7, pp. 32-34.

Ong, M., Ko, T. and Hodari, A. (2016), "Agency of women of color in STEM: Individual and institutional strategies for persistence and success", in Branch, E.H. (Ed.), *Pathways, Potholes and the Persistence of Women in Science: Reconsidering the Pipeline*, Lexington Books, New York, NY, pp. 183-195.

Ong, M., Wright, C., Espinosa, L. and Orfield, G. (2011), "Inside the double bind: a synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering and mathematics", *Harvard Education Review*, Vol. 81 No. 2, pp. 172-208.

Reskin, B. (1978), "Sex differentiation and social organization of science", *Sociological Inquiry*, Vol. 48, pp. 491-504.

Rosser, S.V. (1995), *Teaching the Majority: Breaking the Gender Barrier in Science, Mathematics and Engineering*, Teachers College Press, New York, NY.

Rosser, S.V. (2004), *The Science Glass Ceiling: Academic Women Scientists and the Struggle to Succeed*, Routledge, New York, NY.

Rosser, S.V. and Chameau, J.L. (2006), "Institutionalization, sustainability, and repeatability of advance for institutional transformation", *Journal of Technology Transfer*, Vol. 31 No. 3, pp. 335-344.

Settles, I.H., Cortina, L.M., Malley, J. and Stewart, A.J. (2006), "The climate for women in academic science: the good, the bad, and the changeable", *Psychology of Women Quarterly*, Vol. 30, pp. 47-58.

Smith, J.L., Handley, I.M., Zale, A.V., Rushing, S.A. and Potvin, M. (2015), "Now Hiring! Empirically testing a 3-step intervention to increase faculty gender diversity in STEM", *BioScience*, Vol. 65 No. 11, pp. 1084-1087, doi: 10.1093/biosci/biv138.

Steinpreis, R.E., Anders, K.A. and Ritzke, D. (1999), "The impact of gender on the review of the curricula vitae of job applicants and tenure candidates: a national empirical study", *Sex Roles*, Vol. 41 Nos 7/8, pp. 509-528.

Stewart, A., Malley, J. and LaVaque-Manty, D. (2007), *Transforming Science and Engineering Advancing Academic Women*, University of Michigan Press, Ann Arbor, MI.

Sturm, S. (2006), "The architecture of inclusion", *Harvard Journal of Law and Gender*, pp. 248-298.

Valian, V. (1998), *Why So Slow?*, MIT Press, Cambridge, MA.

Wu, L. and Jing, W. (2011), "Asian women in STEM careers: an invisible minority in a double bind", *Issues in Science and Technology*, Vol. 28 No. 1, pp. 82-87.

Xie, Y. and Shauman, K. (2003), *Women in Science: Career Processes and Outcomes*, Harvard University Press, Cambridge, MA.

Further reading

Burrelli, J. (2008), *Thirty-Three Years of Women in S&E Faculty Positions*, National Science Foundation, Arlington, VA, NSF 08-308.

Corresponding author
Jessie DeAro can be contacted at: jdearo@nsf.gov

For instructions on how to order reprints of this article, please visit our website:
www.emeraldgrouppublishing.com/licensing/reprints.htm
Or contact us for further details: **permissions@emeraldinsight.com**

Downloaded by 128.150.202.21 At 07:46 07 March 2019 (PT)