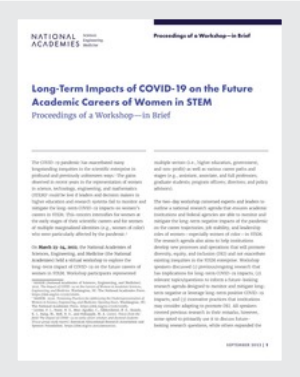

Long-Term Impacts of COVID-19 on the Futur Academic Careers of Women in STEM: Proceedings of a Workshop in Brief (2022)

DETAILS

13 pages | 8.5 x 11 | PDF

ISBN 978-0-309-69271-7 | DOI 10.17226/26687

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SUGGESTED CITATION

National Academies of Sciences, Engineering, and Medicine 2022. *Long-Term Impacts of COVID-19 on the Future Academic Careers of Women in STEM: Proceedings of a Workshop in Brief*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26687.

NATIONAL ACADEMIES Sciences Engineering Medicine

Proceedings of a Workshop—in Brief

Long-Term Impacts of COVID-19 on the Future Academic Careers of Women in STEM

Proceedings of a Workshop—in Brief

The COVID-19 pandemic has exacerbated many longstanding inequities in the scientific enterprise in profound and previously unforeseen ways.[1] The gains observed in recent years in the representation of women in science, technology, engineering, and mathematics (STEM)[2] could be lost if leaders and decision makers in higher education and research systems fail to monitor and mitigate the long-term COVID-19 impacts on women's careers in STEM. This concern intensifies for women at the early stages of their scientific careers and for women of multiple marginalized identities (e.g., women of color) who were particularly affected by the pandemic.[3]

On **March 23–24, 2022**, the National Academies of Sciences, Engineering, and Medicine (the National Academies) held a virtual workshop to explore the long-term impact of COVID-19 on the future careers of women in STEM. Workshop participants represented multiple sectors (i.e., higher education, government, and non-profit) as well as various career paths and stages (e.g., assistant, associate, and full professors; graduate students; program officers; directors; and policy advisors).

The two-day workshop convened experts and leaders to outline a national research agenda that ensures academic institutions and federal agencies are able to monitor and mitigate the long-term negative impacts of the pandemic on the career trajectories, job stability, and leadership roles of women—especially women of color—in STEM. The research agenda also aims to help institutions develop new processes and operations that will promote diversity, equity, and inclusion (DEI) and not exacerbate existing inequities in the STEM enterprise. Workshop speakers discussed (1) previous/ongoing research that has implications for long-term COVID-19 impacts, (2) relevant topics/questions to inform a future-looking research agenda designed to monitor and mitigate long-term negative or leverage long-term positive COVID-19 impacts, and (3) innovative practices that institutions may consider adapting to promote DEI. All speakers covered previous research in their remarks; however, some opted to primarily use it to discuss future-looking research questions, while others expanded the

[1] NASEM (National Academies of Sciences, Engineering, and Medicine). 2021. *The Impact of COVID-19 on the Careers of Women in Academic Sciences, Engineering, and Medicine.* Washington, DC: The National Academies Press. https://doi.org/10.17226/26061.
[2] NASEM. 2020. *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors.* Washington, DC: The National Academies Press. https://doi.org/10.17226/25585.
[3] Levine, F. J., Nasir, N. S., Rios-Aguilar, C., Gildersleeve, R. E., Rosich, K. J., Bang, M., Bell, N. E., and Holsapple, M. A. (2021). *Voices from the field: The impact of COVID-19 on early career scholars and doctoral students [Focus group study report].* American Educational Research Association and Spencer Foundation. https://doi.org/10.3102/aera20211.

discussion to integrate key actions to implement and evaluate DEI practices in academic STEM environments. This proceedings provides a high-level summary of the workshop discussion, including key topics identified by participants for informing a national research agenda on long-term COVID-19 impacts on women in STEM.[4]

WELCOMING REMARKS AND CONTEXT

National Academy of Sciences President **Marcia McNutt** welcomed attendees and thanked the National Science Foundation (NSF) for its support of the workshop. She stressed the need to articulate a research agenda to track and mitigate the impacts of the pandemic on women's research careers. "So much progress could be lost if we are not vigilant about the impact of this pandemic over the long term," she said. Citing remote work as an example, she continued, "It is also important that we seek to maintain those innovations developed in response to the pandemic that may have some benefits for promoting greater diversity, equity, and inclusion."

Planning committee chair **Terri Kinzy**, Illinois State University, thanked McNutt, committee members, and speakers for participating in the workshop. She echoed that the pandemic has exaggerated already-existing challenges for many women. As the workshop began, Kinzy polled the audience to gather their insights on the key topics that should be the focus of a national research agenda on long-term COVID-19 impacts (Figure 1). The audience highlighted several topics in need of investigation; the most frequently mentioned topics are listed here in descending order: "equity," "child care," "caregiver responsibilities," "evaluation," "intersectionality," and "retention and success."

Elena Fuentes-Afflick, University of California, San Francisco, provided context for the workshop by sharing key findings from the 2021 National Academies report *The Impact of COVID-19 on the Careers of Women in Academic Sciences, Engineering, and Medicine* (NASEM, 2021). As a study committee member, she noted the study harnessed a pre-pandemic body of research that documented women's contributions to STEM fields, as

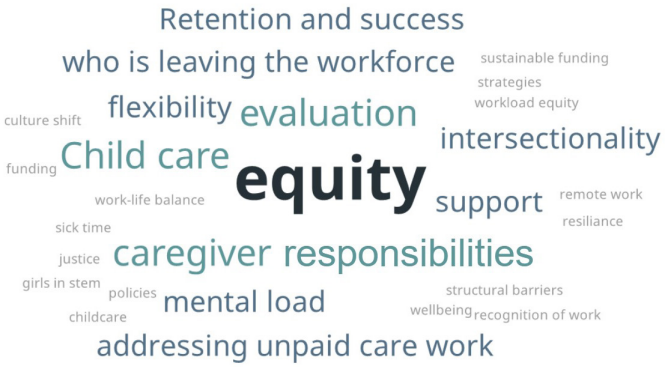

FIGURE 1 Key Topics for a National Research Agenda Submitted by 82 Workshop Participants.
SOURCE: Workshop Poll, March 23, 2022.

well as their underrepresentation, lower salaries, greater stress and discrimination, and greater likelihood of being the primary caregiver or single parent in a family (NASEM, 2020). An important focus of the report was on intersectionality and inequality, particularly impacting women of color. The evidence available in 2020 suggested that the disruptions caused by the pandemic endangered the engagement, experience, and retention of women in academic STEM, Fuentes-Afflick reported. The study also recognized it would take time to fully understand the impact. "The future almost certainly holds additional, unforeseen disruptions," Fuentes-Afflick concluded. "That future requires the contributions of STEM, which can be fully realized only if the well-being of women in these fields does not significantly suffer from the COVID-19 pandemic and other disruptions."

OVERARCHING INSIGHTS ON THE LONG-TERM IMPACT OF COVID-19 ON WOMEN IN STEM

In a session moderated by Kinzy, **Christa Porter**, Kent State University, and **Mary Frank Fox**, Georgia Institute of Technology, presented highlights from their ongoing research that has relevance to the current context.

Porter has researched the intersections of race, gender, and status as seen through the dual pandemics of COVID-19 and racism. She drew on two studies undertaken with colleagues, one on Black women graduates and newer practitioners in higher education[5] and the other on Black

[4] For workshop session recordings and agenda, see https://www.nationalacademies.org/event/03-23-2022/long-term-impact-of-covid-19-on-the-future-careers-of-women-in-stem-a-virtual-workshop.

[5] Porter, C.J. Porter, L. Ward, and L. D. Patton Davis. 2022. Toward Understanding COVID-19's Economic Impact on Black Women in U.S. Higher Education. *Journal of Student Affairs Research and Practice*. DOI: 10.1080/19496591.2021.2006678.

faculty women, especially those in non-tenure track positions.[6] Across both studies, she has seen the need for data disaggregation (i.e., by race, gender, and career status) to avoid conflation, as well as the effects of collective and vicarious trauma on women, particularly Black women, in their academic trajectories. Many women of color shoulder increased responsibilities and hidden labor, such as increased advising loads and service expectations, as well as financial obligations and debt created by long-term disparities and pandemic-caused disruptions. At the same time, she noted a lack of real investment from most departmental and institutional leaders for sustained change, instead opting for reactive responses.

Porter shared lessons for leaders from her research. She suggested they engage in equity audits to review policies and practices; increase accountability for equitable and inclusive cultures; (re)examine reappointment, tenure, and promotion processes to promote equity and inclusion; weigh the intent versus the impact of reactive policy changes; show up as a "co-conspirator" to enact change; and develop a critical awareness of gendered and racial realities.

Fox studies how work settings bear on women's participation and status in the STEM academic workforce. As context, she reminded participants that scientific fields frequently involve on-site collaboration in an interdependent enterprise. She focused on three social-organizational features of work settings that are marked by gender disparities and bear on the long-term impacts of the pandemic: (1) frequency of speaking about research within the "home unit," (2) span of collaboration, and (3) characterizations of the climate of one's home unit.

Fox's study of nine research universities showed women were significantly less likely to report speaking daily with other faculty in their units about their research, which the pandemic further disrupted.[7] This is consequential, she said, because frequent discussions are a predictor of clarity of criteria for tenure and promotion. Second, while collaboration is the norm in scientific fields, "span" relates to collaboration outside of home units; a wide span is associated with publication productivity. While women are generally as likely as men to collaborate in research, the pandemic resulted in a sharper decline in new projects among women, according to one study.[8] The decline has implications for new collaborations, the span of collaboration, and future and long-term productivity, Fox said. Third, the perception of the work climate can stimulate or stifle performance. She has found women are less likely to report work settings as informal, exciting, helpful, creative, and inclusive, and more likely to report them as stressful.[9] Collegial climate leads to clarity of criteria for tenure and promotion, especially among women scientists. Dr. Fox concluded with questions about institutional attention and the agenda ahead. First, she asked how institutions can shape the continuing future and meaning of work settings to support women, especially women of color. Second is how interaction, communication, and collaboration can adapt in inclusive and effective ways. Third is how to develop work climates so the pandemic prompts positive change toward the thriving of academic women in STEM.

When asked about barriers for leaders to implement change, Porter identified tradition. Tenure and promotion processes are embedded in the academy, and people must be willing to change, even with small steps that lead to long-term equity. She also identified lack of acknowledgement about what happens around promotions for women of color. It is important to look at the data and perhaps be uncomfortable with the results. Fox identified as a barrier the decentralized structure of academia, not just within departments but also within research units and labs. She also observed that many processes are informal, such as the selection

[6] Porter, C.J., G. Jones Boss, T.J. Davis. 2022. Just because it don't look heavy, don't mean it ain't: An intersectional analysis of Black women's labor as faculty during COVID. *Gender, Work & Organization* 1468-0432 10.1111/gwao.12820.

[7] Fox, M.F. 2010. Women and Men Faculty in Academic Science and Engineering: Social-Organizational Indicators and Implications. *American Behavioral Scientist* 53: 997-1012. https://doi.org/10.1177/0002764209356234.

[8] Gao, J. et al. 2021.Potentially long-lasting effects of the pandemic on scientists. *Nature Communications* 12:6188. https://doi.org/10.1038/s41467-021-26428-z.

[9] Fox, M.F. 2010. Women and Men Faculty in Academic Science and Engineering: Social-Organizational Indicators and Implications. *American Behavioral Scientist* 53(7):997-1012. DOI:10.1177/0002764209356234.

of teammates and regarded as important to faculty autonomy, which makes interventions challenging.

When Kinzy asked how to monitor the long-term impacts of the pandemic, Porter stressed qualitative research to understand individual experiences, taking care not to exploit and tokenize people, in addition to quantitative research. Fox urged attention to attrition. "The data and analyses are based on those who are employed," she stated. "We need to find ways to track, trace, and assess those who have exited. Otherwise, we are continuing to base our analyses on those who have managed to survive."

They agreed with participants who most frequently articulated "burnout" as a concern followed by other concerns, such as "disengagement from STEM," and "stagnation" (Figure 2). Porter stated it is not enough to espouse the need for change without action. COVID-19 has revealed realities and inequities. "If we are not willing to get into what is really happening and hold people accountable, what are we doing it for," she asked. Fox suggested federal funding agencies could introduce some means of accountability. Fox concluded by urging, "Consider the work settings, and then consider how the settings may have faded during the pandemic. Take that as an opportunity to reshape settings in significant and inclusive ways." Both presenters emphasized that "going back to normal" or "recovery" is not the solution, as the past was not equitable.

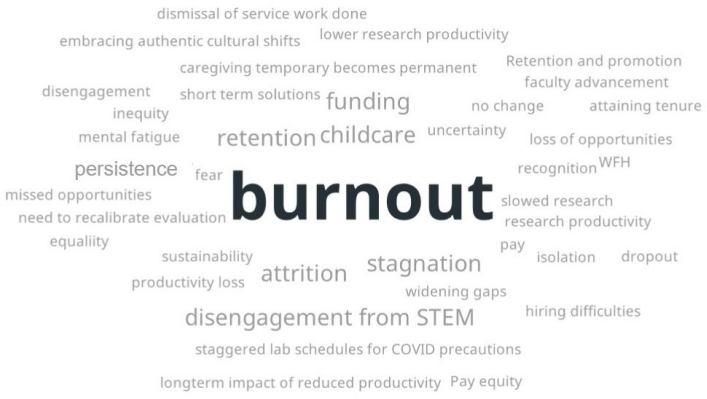

FIGURE 2. Concerning Long-Term COVID-19 Impacts Identified by 49 Workshop Participants.
SOURCE: Workshop Poll, March 23, 2022.

IMPACTS ON ADVANCEMENT AND ATTRITION OF WOMEN IN ACADEMIC STEM CAREERS AND LEADERSHIP ROLES

Planning committee member **Adia Harvey-Wingfield**, Washington University in St. Louis, moderated a panel that expanded on the advancement and attrition issues identified by Porter, Fox, and participants.

Irina Buhimschi, University of Illinois, Chicago (UIC), explained that UIC is part of the National Institutes of Health (NIH) Building Interdisciplinary Research Careers in Women's Health program.[10] A study on work-life balance, coping, and productivity emerged when participants questioned how their own experiences during the pandemic reflected those of others. A Data-Drive Academic Recovery TEAM (DART) was created with the hypothesis that all researchers experienced change, especially females[11] with a resulting decrease in work productivity. DART surveyed about 500 individuals in UIC's health science colleges in 2020 and 2021 to learn about the effects.[12]

Based on a combination of reported stress, gender, rank, and household composition, the team delineated four main classes. In 2020, productivity particularly decreased for associate/assistant professors with families, most of whom were women. In 2021, stress declined overall, but more for men than women. In other findings, women reported worse self-care, Asian and Black faculty experienced more stress than white faculty, and faculty with younger children had higher concerns about productivity. As institutions move forward in developing policies, Buhimschi stressed that institutional leaders should (1) avoid extrapolating their experience on to others, and (2) broaden diversity of administrative committees (e.g., rank and tenure status).

Researchers from the ADVANCE program at the University of Massachusetts, Amherst (UMass Amherst)

[10] For more information, see https://orwh.od.nih.gov/career-development-education/building-interdisciplinary-research-careers-in-womens-health-bircwh.
[11] In the context of this proceedings, "women" are defined as those who identify as women or are viewed by others as women. However, when referring to research presentations, we use the presenters' terminology to maintain consistency with their reported research and findings.
[12] P. Kotini-Shah et al. 2022. Work-Life Balance and Productivity Among Academic Faculty During the COVID-19 Pandemic: A Latent Class Analysis. *Journal of Women's Health* 31(3): 321-330. https://doi.org 10.1089/jwh.2021.0277.

outlined the program's "TREE Model" for an institutional response to COVID-19, discussed a method to recognize pandemic impacts, and identified long-term strategies to recalibrate evaluation. **Dessie Clark,** UMass Amherst, described TREE: ***Think*** ahead (collect data to understand short- and long-term impacts), ***Resources*** (help faculty navigate the impacts), ***Evaluation*** (adjust for pandemic impacts), and ***Equity*** (as a guiding principle throughout).[13] Data to collect include issues that demand time but do not usually factor into tenure and promotion decisions, such as mentoring, student support, adapting teaching strategies during the pandemic, community engagement, and family care. Resources include flexibility and remote work, teaching support, care support, and recovery planning. Related to evaluation, "addressing disparities now helps ensure inclusion and diversity for the long term," Clark said. She also noted some institutions sidelined equity concerns in the past few years, but those most successful in riding out the pandemic "kept equity front and center."

Joya Misra, UMass Amherst, described an innovative resource that institutions may consider adapting to recognize impacts: pandemic statements,[14] which UMass Amherst adopted in July 2020. Training and tools were provided to faculty on how to write the statements and to evaluators on how to use them. The statements document specific impacts, both positive and negative. They allow evaluators to understand an individual's work context, workload changes, and (when a person wishes to share it) care/health context. Misra stressed the need to rework evaluation, which she noted was already a problem pre-pandemic. Evaluators often are at a more senior career stage, with different caregiving responsibilities and less diversity than those whom they evaluate. They also may not have experienced the pandemic in the same way as those being evaluated.

Ethel Mickey, UMass Amherst, reviewed three evaluation-related policy adjustments: suspending teaching evaluations, tenure delays, and the pandemic impact statements.[15] While providing "quick fixes," they still center evaluation on research productivity, she said, and further recalibration is needed to achieve long-term institutional equity. Recalibration of faculty evaluation requires "institutions to align their standards to the relative resources and opportunities available to faculty at a given time," stated Mickey. This might include evaluating faculty work holistically (i.e., recognize potential biases in performance indicators, expand definitions of teaching excellence, and emphasize quality over quantity) and re-centering diverse knowledge (i.e., broaden what counts as productivity and include community-engaged work). Another step towards recalibration includes reconsidering tenure/promotion timelines and offering flexible options (e.g., length of delay, timing of review, and mechanisms to recoup lost income due to tenure delay).

Misra stressed the need to retrain evaluators by providing clear training on COVID-19 impacts, ensuring evaluators discuss case studies to identify evaluation strategies based on pandemic statements and external reviewers' letters, as well as developing best practices ***before*** evaluations take place. Commenting that institutions often fear recalibrating evaluations and changing standards, Misra said, "what we are asking is, think about people's productivity in the context of their workload and the context in which they carried out the work."

When asked about the adaptation of pandemic statements to other academic personnel that are not tenure-track faculty, Misra noted the broad interest in and use of the pandemic statements by graduate students, postdoctoral researchers, and university staff. In addition, she underscored that the pandemic statements are crucial for ensuring pandemic recovery plans are considering the various impacts across diverse academic groups. UMass ADVANCE researchers also discussed approaches to prevent pandemic impact statements being used against individuals.[16]

[13] Clark, D., E. Mickey, and J. Misra. 2022. Growing the Roots of Equity: The TREE Model of Institutional Response to COVID-19. *Journal of Diversity in Higher Education.* https://doi.org/10.1037/dhe0000392.
[14] J. Misra, E. Mickey, and D. Clark. 2020. Addressing and Documenting Pandemic Impacts. *ADVANCE Journal* 2(2).
[15] E. Mickey, J. Misra, and D. Clark, 2022. The Persistence of Neoliberal Logics in Faculty Evaluations amidst COVID-19: Recalibrating towards equity. *Gender, Work & Organization*.
[16] For UMass ADVANCE tools and resources, see https://www.umass.edu/advance/resources-and-tools.

Misra acknowledged the difficulty for institutional leaders operating in inequitable systems to interact with the TREE Model. In working with other universities, she observed many leaders are committed to equity, while it is not on the agenda for others. In response to a question on evaluating the use and effectiveness of institutional policies, Mickey highlighted the need to examine the implementation of policies at local departmental levels, which vary by discipline and culture. Buhimschi urged both trickle-down and grassroots approaches to effect change.

Workshop participants asked about the "great resignation"[17] and proactive strategies for retaining senior underrepresented faculty. As senior faculty retire, expertise will be lost, perhaps losing people who could become leaders, commented Misra. She called for research on interventions to make academia meaningful to diverse faculty. Mickey said institutional leaders can use data collection to understand what faculty need. Clark added that it was valuable to "meet people where they are" by developing data collection mechanisms that accommodate different comfort levels and needs. Buhimschi called for more funding towards qualitative work to support research on the resources and supports faculty need to be productive within their institutional environment.

IMPACTS OF COVID-19 ON FAMILY CAREGIVERS

As noted throughout the workshop, many women caring for children or other family members had increased responsibilities during COVID-19. Presenters in this panel, moderated by planning committee member **Jerry Jacobs,** University of Pennsylvania (UPenn), offered insights based on their ongoing research on these issues.

Sarah Damaske, Pennsylvania State University, shared findings on challenges identified by computer science, engineering and math (CSEM) workers. She noted recent research shows that STEM workers have many of the same demands as workers in other fields, but they tend to leave STEM at much higher rates than in other fields. As a work and family scholar, Damaske wanted to see what might be missing in the explanations about what is termed the "leaky pipeline."

Damaske surveyed about 4,000 CSEM individuals to identify challenges related to skills, work-family concerns, and discrimination. Because it took place between April and June 2021, she commented, it also "became a COVID story." Women were less likely than men to report that their biggest challenges were related to skills or interpersonal relations in the workplace. Women reported work-life balance as their biggest challenge; however, this challenge appeared to be less significant for women with longer tenure, either because women may have left STEM or aged out of some work-family demands. Of note, the biggest difference by gender is that women were more likely to report discrimination-based challenges based on sex, race, or disability. From her research, she concluded, "many of the responses to COVID-19 in the academy and beyond have been to focus on individual-level accommodations. Our research suggests the need for systemic responses. Individually tailored responses will only serve to increase bias."

The prevailing notion is that science venerates meritocracy, with the university as a sacred space and academics believing they can objectively evaluate scientific work, commented **Mary Blair-Loy**, University of California San Diego. Blair-Loy expressed the hope that the pandemic inspires cultural and structural change, but said she fears it will harm groups already culturally devalued. She reported on a study she conducted with Erin Cech on a highly ranked public university that had a transparent academic review system and made faculty job level and salaries public.[18] Surveys and interviews showed a hegemonic belief across all groups surveyed that assessment of merit and the tenure and promotion process are fair. No mean demographic differences were seen in scholarly production, work dedication, or work hours. Yet, she said, women, mothers, racially minoritized men, and LGBTQ faculty fare worse than white and Asian

[17] For more information on this term, see https://www.pewresearch.org/fact-tank/2022/03/09/majority-of-workers-who-quit-a-job-in-2021-cite-low-pay-no-opportunities-for-advancement-feeling-disrespected/.

[18] M. Blair-Loy, and E. Cech. 2022. *Misconceiving Merit*. Chicago: University of Chicago Press.

heterosexual men, on average, in terms of respect for their research, professional integration, and salary. To explain the disparity, she and Cech analyzed core features of STEM as broadly accepted cultural schemas, such as defining scientific work as a calling that demands intensive identification with the work, single-minded allegiance, and at times transcendent inspiration. The schema's "ugly underbelly" is the belief that mothers are more distracted and less devoted to science, even though on average, mothers' productivity is equal to others. Another schema relates to the disciplinary ideal that a scientist is brilliant and creative, as well as assertive, competitive, and self-promoting. This schema devalues concern for diversity and equity, seeing it as politicized and potentially corrupting objectivity, she said. Self-described assertive faculty earn higher salaries but do not produce more articles or earn more grant dollars, she said, yet demonstrating assertiveness is risky especially for Black and Latinx women.

White and Asian heterosexual men, already most likely to be respected and connected, lost the least during the pandemic, according to Blair-Loy's findings. In contrast, mothers, assistant professors already worried about starting a family, and racially minoritized faculty lost the most. Given the schema around scientific excellence and work devotion, these faculty groups could incur risks if they advocate for and utilize pandemic-impact policies. Blair-Loy urged confronting these schemas directly through evidence-based peer education and policies, tracking data and adjusting as needed, enhancing benefits for those doing the most mentoring and care-giving, and compensating for the loss of time during the pandemic with sabbaticals and teaching releases over the next several years.

As **Larissa Mercado-López,** California State University, Fresno, related, her work on democratizing higher education through institutional support for caregivers started with her own experience as a student-parent and grounding in intersectional feminism. She identified several failures in responding to the pandemic at her institution. First, when faculty notified the administration about making instructional and research pivots while caring for children full-time, a faculty-parent group was suggested. This action shifted responsibility from the institution to a volunteer group with no resources. When the group realized it did not have the capacity to support each other, members made concrete requests to the administration, but implementation depended on the benevolence of individuals, not systems. Campus solutions were subjective and not actionable, she added. For example, faculty could include a COVID-19 statement during review, but without any guidance. Finally, there were no indicators of faculty parent support and success.

Mercado-López commented on seven warning signs that "institutions are not caring well."[19] Her calls to action for caregiver support in higher education include: intentionally anchor faculty/staff success in equity, anti-racism and opposition to bigotry; commitment to becoming a family-serving (not just "family friendly") campus (e.g., create goals for caregiver retention in strategic plans); widespread communication about community responsibilities to support caregivers; creation of equity goals that consider intersecting inequity categories (i.e., race, gender, and caregiving identities); faculty/staff caregiving representation on relevant committees; academic leadership accountability; definition of faculty/staff work life in ways that prioritize equity, safety, self-preservation, and joy; and mechanisms for complaints that ensure protection from retaliation.

Jacobs commented that suggestions for change included those from Blair-Loy to confront prevailing schema, from the UMass ADVANCE to broaden the definition of faculty excellence, and from Mercado-López to develop alternative criteria on caring. He asked about potential strategies to change cultural schema in the university setting. Blair-Loy noted that scientists often respond to data; in her study, the data show perceptions of excellence are not necessarily linked to productivity and creativity, yet the flawed metric leads to inequitable

[19] Tronto, J.C. 2010. Creating Caring Institutions: Politics, Plurality, and Purpose. *Ethics and Social Welfare* 4(2):158–171. https://doi.org/10.1080/17496535.2010.484259.

outcomes. Damaske commented on the ideal in academia that more is better. "We don't stop to ask why," she commented. "What is it about the bars we have set?" From a non-STEM perspective, Mercado-López said other disciplines have their own schema of excellence that should be examined. Clarity around expectations is important, she said.

Several participants questioned how universities will have the resources to compensate for care or lost time. Blair-Loy recognized resources are limited, but suggested solutions could vary. For example, paying an excellent lecturer to deliver a course is not expensive compared to losing excellent faculty who do not get tenure because of pandemic-related issues or become frustrated and leave. She also acknowledged counteracting stigmas and disrupting the schema of scientific excellence is difficult. For example, her institution used to only offer paid family leave to birth mothers. Broadening paid leave to all parents, and perhaps also covering elder care, could give these policies more legitimacy. Damaske agreed many family-friendly policies are gender-specific. Accommodations rolled out on a case-by-case basis versus blanket institutional policies add to the stigma. Mercado-López stressed holding leaders accountable. "I always go back to the need to institutionalize these commitments by showing how caregiver retention moves the needle on institutional goals," she said. "We should mandate that leaders report on their success, with public-facing data, which would help in accountability."

INSIGHTS FROM FEDERAL AGENCIES

As primary funders of academic research, NSF and NIH have important roles to play in understanding the impact of COVID-19 on women's careers in STEM. In this session, Fuentes-Afflick posed a series of questions to **Jessie DeAro**, NSF and **Xenia Tigno**, NIH about their agencies' approaches to track COVID-19 impacts on the scientific workforce and advance research on priority issues.

DeAro pointed to NSF's ongoing data collection to monitor peer review participation and success rates, available through the National Science Board.[20] The latest, published in 2020, does not cover the principal impact of the pandemic, but 2021 and 2022 data, when available, will cover more of the period. Tigno described three surveys[21] conducted from July to October 2020 with the NIH intramural workforce, extramural researchers, and research administrators. Among the NIH workforce, 44 percent indicated caretaking was an important part of their lives, and 1 in 5 said caretaking made work more difficult to complete.[22] Among those most negatively impacted were research personnel, early career researchers involved in clinical care, those caring for young children, men in caretaking roles, and trainees, especially those on visas. In the extramural survey,[23] 55 percent said the pandemic would negatively impact their career trajectory, especially lab-based researchers and early and mid-career faculty. Strong predictors of lower productivity were attributed to societal and political events, as well as physical and social isolation. Early career researchers were more negatively impacted than mid-career and senior researchers for factors affecting mental health. Investigators with children under age 5 were most likely to report harmful effects on their productivity and trajectory.

In terms of tracking data over time, DeAro noted about 5,000 fewer proposals were submitted between 2018 and 2020. It will be important to look at who did not submit proposals and how to support participation, she said. NSF communicated with current grantees about flexibility in managing their grants during the pandemic. The National Center for Science and Engineering Statistics (NCSES) will have data to cover the pandemic period, she noted.[24] NIH also tracks grant submissions, Tigno said.[25] NIH's response to issues identified in the three surveys include funding and eligibility flexibilities, administrative supplements for unanticipated costs due to COVID-19, and personal statements included in applications that reviewers can take into account. NIH also tracks race and

[20] For more information, see https://nsf.gov/nsb/index.jsp.

[21] For more information, see https://diversity.nih.gov/building-evidence/covid-19-impact-surveys.

[22] For more information, see https://diversity.nih.gov/sites/coswd/files/images/docs/25690_Trans-NIH_COVID-19_Executive_Summary_508_v2.pdf.

[23] For more information, see https://nexus.od.nih.gov/all/2021/03/25/the-impact-of-the-covid-19-pandemic-on-the-extramural-scientific-workforce-outcomes-from-an-nih-led-survey/.

[24] For more information, see https://ncses.nsf.gov.

[25] Results are regularly posted on the blog OpenMIKE (https://nexus.od.nih.gov/all/category/open-mike/) and on the extramural NEXUS website (https://nexus.od.nih.gov/all/).

gender-based disparities in grant applications, and Dr. Tigno shared data from 2019 to 2021.[26]

Fuentes-Afflick asked how NSF and NIH view any positive disruptors resulting from the pandemic. DeAro agreed with previous speakers that the pandemic exacerbated existing issues by gender and race. A positive aspect is that, as a result, these existing inequities were made clearer to those not impacted by them. ADVANCE program[27] grantees made progress on their campuses in discussing systemic inequities with an intersectional lens about policies and practices. Another positive impact was that NSF recruited remote-working program officers who would not have moved to NSF headquarters. Tigno related that 58 percent of the NIH respondents said telework had a positive impact on their productivity and work-life balance. An increased sense of mission also drove productivity. Extramural researchers reported the advantages of virtual conferences related to greater access, less cost, reduced carbon footprint, improved participation of women, and increased access for people with disabilities or international stakeholders.

Fuentes-Afflick turned to NSF and NIH programs designed to support gender equity in research. DeAro described the ADVANCE program, which has focused on gender equity in organizations through systemic change models since 2001. She opined that this program better positioned NSF to respond to the pandemic with solutions that ADVANCE grantees had developed and tested over time. She also pointed to a suite of NSF career-life balance programs begun in 2012.[28,29] No new policies were created during the pandemic, but current policies were interpreted to apply to the situation. Although these policies only directly affect those with NSF support, DeAro said, "hopefully, the NSF set expectations for institutions to fill in that gap for other grad students, postdocs, and faculty." As learned from ADVANCE, the existence of policies alone are not sufficient; people must know about and trust them, she said. Tigno highlighted some of NIH's[30] family-friendly programs[31] for researchers related to leave, supplements,[32,33,34] and biosketch guidelines.[35]

DeAro and Tigno considered how information gained through research can support policies and practices. DeAro provided an example on basic research on implicit bias. Implicit bias training developed by the University of Michigan ADVANCE Institutional Transformation grant was adapted for use in training NSF peer reviewers in one NSF division in 2007 and has since become part of the standard panel training used widely throughout NSF. Training on implicit bias alone is usually not adequate to change behavior, she acknowledged, but it is important to create structures, accountability, and processes. NIH is also launching a new Advancing Gender Inclusive Excellence Program[36] and initially will fund a data-coordinating center aimed at women attaining leadership.

Tigno said NIH initiatives are informed by what is learned from stakeholders. National Academies reports have also informed NIH efforts, such as ***Beyond Bias and Barriers***,[37] which led to a trans-NIH working group co-led by the NIH director and director of the Office of Research on Women's Health (ORWH). Former NIH Director Francis Collins requested bold ideas to address recommendations from the National Academies' ***Promising Practices*** report, which has led to a NIH challenge prize[38] to recognize institutions that have systematically addressed gender diversity and equity issues.

[26] See R01 Grant Applications, 2019 to 2021 at https://nexus.od.nih.gov/all/2021/10/20/more-data-on-applications-submitted-during-the-pandemic/.
[27] For more information, see https://beta.nsf.gov/funding/opportunities/advance-organizational-change-gender-equity-stem-academic-professions-advance.
[28] For more information, see https://www.nsf.gov/career-life-balance/.
[29] For more information, see https://www.nsf.gov/career-life-balance/clbfaqs.jsp.
[30] For more information, see https://grants.nih.gov/grants/guide/notice-files/not-od-11-045.html.
[31] For more information, see https://grants.nih.gov/grants/policy/nih-family-friendly-initiative.htm.
[32] For more information, see https://grants.nih.gov/grants/guide/notice-files/NOT-OD-20-054.html.
[33] For more information, see https://grants.nih.gov/grants/guide/notice-files/NOT-OD-20-055.html.
[34] For more information, see https://grants.nih.gov/grants/guide/notice-files/not-od-21-134.html.
[35] For more information, see https://grants.nih.gov/grants/guide/notice-files/not-od-11-045.html.
[36] For more information, see https://grants.nih.gov/grants/guide/rfa-files/rfa-od-21-010.html.
[37] NASEM. 2007. *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering.* Washington, DC: The National Academies Press. https://doi.org/10.17226/11741.
[38] For more information, see https://orwh.od.nih.gov/in-the-spotlight/all-articles/nih-launches-challenge-prize-address-gender-diversity-and-equity.

Fuentes-Afflick asked how the National Academies and the broader community could serve the agencies as a resource. DeAro said she greatly appreciated the National Academies' role in identifying research agendas and translating research findings to policy and actionable items. Tigno said NIH, especially at ORWH, welcomes further collaboration with the National Academies, NSF, and other agencies to achieve gender equity. Areas of collaboration might include child and elder care (which translates into unpaid care work), burnout, mental health, and partnerships to move the needle, she said. Looking ahead, DeAro said NSF will continue to monitor the agency's progress in achieving its equity goals in grant processes. Internal committees are continuing to respond, such as the NSF career-life balance initiative, sexual harassment terms and conditions,[39] and related Dear Colleague letters. Tigno said ORWH, especially the Careers section, is dedicated to monitoring these issues on an ongoing basis to identify urgent areas and respond efficiently.

IMPACTS OF COVID-19 AND STRUCTURAL RACISM ON WOMEN OF COLOR IN STEM

Planning committee member **Suzanne Barbour**, University of North Carolina at Chapel Hill, drew from Porter's earlier presentation about the dual pandemics of COVID-19 and racism. She moderated a panel in which **Sharla Alegria,** University of Toronto, and **Lori Patton Davis**, The Ohio State University (OSU), discussed strategies focusing on women of color.

Alegria explained her research focuses on how inequalities persist in institutions that at least ostensibly embrace DEI goals, particularly in computing. For data on the current state of affairs of women of color in STEM, she drew from NCSES and her own research with tech workers. Over the past several decades, women's representation in science and engineering has generally trended up in most fields (while still low), but decreased in math and computer science. Moreover, representation of Black women in science and engineering, especially in math and computer science, is only one-half to one-third of their representation in the overall population.

[39] For more information, see https://www.nsf.gov/od/oecr/harassment.jsp.

A survey within Silicon Valley tech firms shows a significant division of labor, she reported. Asians have high participation but often not in decision-making roles. Women occupy some managerial but few executive roles, and Black and Latinx participation is very low overall. Women of color face both gender and racial barriers, Alegria pointed out from these data. She said her research shows the division of labor in tech firms creates barriers to advancement, with white women on "more of a step stool than an escalator."[40] They are encouraged to take on managerial positions that do not lead to executive roles. Women of color, in contrast, need additional credentials or must change companies to advance. Given structural gendered racism, Alegria posited COVID-19 might further challenge the careers of Black women in STEM. COVID-19 led to a shift in digital work, high personal and emotional costs, and worsening of existing inequalities. Yet, an early survey by Future Forum also found that Black workers in particular expressed satisfaction with remote versus office work, although she said further research is needed.

Alegria concurred with previous speakers that COVID-19 did not necessarily create new inequalities, but made them clearer. As one area of concern, she said enrollment increased in for-profit colleges, particularly among women of color and older students, but these institutions often lead to lower opportunities than traditional institutions to enter academic STEM. Alegria suggested learning from fields with greater success in DEI, learning from alternatives to traditional higher education (i.e., greater flexibility and access of for-profit offerings), monitoring data on policies and interventions in addition to individual data, and focusing on the equity and inclusion aspects of DEI. Alegria stated that, "diversity is somewhere between illusory and unimportant without equity and inclusion."

In sharing an intersectional reflection on STEM and academic leadership pathways, Patton Davis stressed she enters the discussion as a Black woman who grapples with this intersection daily, dealing with invisibility

[40] S. Alegria. 2019. Escalator or step stool? Gendered labor and token processes in tech work. *Gender & Society* 33(5): 722–45. https://www.org/doi: 10.1177/0891243219835737.

and hypervisibility. As a department chair, she said, she strives to make and be a difference. To do work that matters, she needs to have a level of consciousness about equity, notice the dynamics of racism and inequity when they occur, and explicitly name them. Patton Davis noted her own pathway as a department chair has been influenced by the presence of other STEM women leaders at OSU. Patton Davis urged learning more about the nuanced pathways that lead women of color to STEM, given the few numbers. They should be celebrated, she said, but it is also important to question why so few Black women are in leadership positions. Patton Davis noted she uses intersectionality as a framework to make sense of it, commenting she did not learn about this concept until graduate school and, even then, not through her discipline's formal curriculum. She said intersectionality helped her understand what was happening—it was never just racism, classism, or sexism, but the confluence that resulted in her not being invited to join research teams or learn about other opportunities or to receive feedback that her research on Black women was "too narrow."

Intersectional failures related to Black women include being invisible and hypervisible; being expected to love unconditionally, such as maintaining loyalty even in toxic work environments; being overextended and undersupported; and extending labor for diversity work, Patton Davis stated. COVID-19 placed burdens on women as primary caregivers and had economic effects, but it did not necessarily shift the predicaments of Black women, she said.

She concluded by urging a move away from the language of resilience and grit to consider thriving. She called for moving from "underrepresented minorities" to more specificity, such as Black women, Latinx women, or Indigenous women, to comprehensively understand the experiences of women of color. While she focused on Black women in STEM, she noted that intersectionality will point out larger issues, such as how promotion and tenure policies can work for people in ways that do not reinforce oppression.

Barbour reflected from the presentations that numbers are important but narratives have to be considered too. Related to narratives, Alegria suggested better understanding about the people who are moving out of higher education spaces. Patton Davis echoed the need to capture people's stories and how they navigated COVID-19.

Barbour asked about alternative pathways into STEM fields. Alegria noted the institutionalization of computer science is recent, and there is more acceptance of training programs. She said, however, it is difficult to see how for-profit higher education translates to a pathway to traditional research spaces. Similarly, some universities have alternative paths to full professorship and they may represent a way for Black and other underrepresented women to get into leadership, Barbour suggested. Patton Davis called it a "both/and" situation: "Alternative pathways signals to me that rather than deal with structural issues, we will create another piece. Alternative pathways place the burden on women to go in a different direction, rather than disrupting what currently exists." She called attention to the HERS Institute, which supports women in higher education leadership,[41] but also urged leadership training with the men who occupy the overwhelming majority of these roles. "The work cannot solely be on women to educate male leaders. There must be a commitment from the institution," she said.

IMPACTS OF VIRTUAL ACADEMIC ENVIRONMENTS

As noted throughout the workshop, the transition to remote work has been both a positive and negative disruptor. Presenters in the final session, moderated by **Laura Perna**, UPenn, discussed virtual work as well as general perspectives on work-life balance in academic STEM.

Perna began by asking the panel what they learned about work-life balance during the pandemic. **Margaret Sallee**, University of Buffalo, reflected that she, along with other faculty and graduate student parents, felt overwhelmed. She expressed worry that the submission of fewer

[41] For more information, see https://www.hersnetwork.org/programs/hers-institute/.

proposals and articles, particularly by caregiving women early in the pandemic, will have implications on long-term advancement. She noted an ongoing study that has found 70 percent of mothers and 54 percent of fathers are stressed, about half feel hopeless and depressed, and very few are getting enough sleep.[42]

As part of an NSF-funded team, **Craig Ogilvie**, Montana State University, surveyed graduate students at 12 universities across the country early in the pandemic and one year later. Among the most striking results, about 30 percent of students reported symptoms consistent with post-traumatic stress screening. That is a wake-up call, he said, to do better in graduate education. In focus groups, graduate students reported pressure by faculty to continue their research along with other responsibilities, which he referred to as the Ideal Worker framework.

Heather Shipley, University of Texas San Antonio (UTSA), said these observations resonated at all levels of faculty at UTSA. At this Hispanic-Serving Institution, faculty and students have a range of caregiving dynamics. Stress levels increased when "work became home," but some faculty worried about the stigma if they expressed their difficulties. It has been important to think about support systems for faculty and students, she said.

Perna noted the importance of support systems based on an understanding of people's experiences and the long-term impacts of COVID-19, and asked about the data needed to inform policy and practice. Ogilvie urged starting with the "big question": how to make graduate education more humane and consider the whole student. Many innovative initiatives are going on around the country, but there is no coherent framework to organize research questions and data collection, he said. Given the survey results he shared, he said a trauma-informed framework may be one to consider. This may lead to data collection to design trauma-informed graduate education practices related to students' basic needs, collaboration, and empowerment. Shipley added it is important to determine the pre-pandemic data available as a benchmark and what data may be needed in the future, such as data related to mental health and well-being, student success outcomes, tenure and promotion, and faculty recruitment. Sallee suggested the need to rethink evaluation structures. "We are so concerned about particular metrics, but it is time to rethink the metrics," she said. "[The current structure] penalizes anyone who is not the 'Ideal Worker.'"

How might digital technologies affect DEI initiatives Perna asked the panel. Shipley commented the digital divide is getting wider, and UTSA had to provide loaner laptops, enhanced online access, and other supports to students. Another potential disadvantage is the impact on faculty engagement. However, she continued, virtual work has also led to better attendance and more participatory interactions in many situations. Sallee commented on the shift as some people return to campus and others continue to work remotely. Working in the office creates opportunities, especially for graduate students and early career faculty, and she worries about inequities compounding. The solution will not be the same for everyone, she emphasized. Ogilvie saw benefits in online graduate education, but also expressed concern about the loss of protective support from faculty advisors. He suggested professional development on good practices for virtual advising. Graduate students also gain from interaction with their peers, and he expressed worry about isolation and lack of development of peer-to-peer networks. Setting boundaries in a virtual environment is important as well. Shipley said there has been discussion at UTSA about which types of work are done on different platforms.

Regarding the retention of graduate students in academia, Ogilvie said data already showed that graduate students, especially underrepresented minorities, are becoming less interested in faculty jobs. He urged presenting graduate students with potential career options, one of which is a faculty position. Universities have to think through a flexible hiring pathway that takes into account that applicants may have stepped away for a while, he continued.

Awareness of the different needs of people has increased during the pandemic, and this plays out in virtual work.

[42] M.W. Moyer. 2022. Latest COVID Surge Pushes Parents to Next-Level Stress. Available: https://www.scientificamerican.com/article/latest-covid-surge-pushes-parents-to-next-level-stress1/.

Shipley said UTSA embraced hybrid work environments and keeping flexibility is important. One benefit has been how students, many of whom work 20 to 40 hours a week, can interact with faculty more easily. Ogilvie said, through a trauma-informed lens, predictability and empowerment are important. Sallee noted many universities responded immediately in 2020 with policies and practices, but some are sunsetting them, such as automatic extensions on the tenure clock. She hopes institutions have the will to address barriers and shift culture, such as changing tenure requirements or shifting to virtual environments, while still adhering to their mission.

To conclude, Sallee said virtual work offers a "both/and situation." She suggested people opting in when it works well for them, but also building in opportunities for connecting and building community. Children should be welcome at all events with an acknowledgment that work environments will differ and that is what makes life richer. Ogilvie said the pandemic has shown the need to pay attention and allocate budget to students' basic needs. Shipley said if universities take the opportunity to look hard, they can come out on the other side stronger and better organizations than they were.

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REVIEWERS To ensure that it meets institutional standards for quality and objectivity, this Proceedings of a Workshop—in Brief was reviewed by **ENOBONG BRANCH**, Rutgers University; **KC CULVER**, University of Alabama; and **TINA SALGUERO**, University of Georgia.

SPONSORS This workshop was supported by the National Science Foundation.

Suggested citation: National Academies of Sciences, Engineering, and Medicine. 2022. *Long-Term Impacts of COVID-19 on the Future Academic Careers of Women in STEM: Proceedings of a Workshop—in Brief*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26687.

For additional information regarding the Long-Term Impact of COVID-19 on the Future Careers of Women in STEM, visit https://www.nationalacademies.org/our-work/long-term-impact-of-covid-19-on-the-future-careers-of-women-in-stem-a-workshop.

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