



"Everything is on fire": The Uneven Impact of COVID-19 on Women Faculty

Cindy Blaha ¹, Anne Cox ², Beth A. Cunningham ³, Anne-Barrie Hunter ⁴, Rachel Ivie ³, Kristine P.H. Lui ³, Idalia Ramos-Colón ⁵, Barbara Whitten ⁶

Abstract: This work discusses the disparities for women and parents of young children in academia and describes an effective intervention to help mitigate systemic biases. The intervention was our ADVANCE program of Distributed Peer Mentoring Networks (called eAlliances), where groups of 4-5 women academics in physics and astronomy met virtually and regularly to provide advice and support. This work contributes three new aspects: (1) highlights the effect of COVID-19 on the workloads for men and women physics faculty by comparing data collected before and during the pandemic; (2) uses qualitative data analysis to provide insights on the detrimental and disproportionate impact of COVID-19; and (3) shows how eAlliances became a crucial support network for their members during the COVID-19 lockdowns. Our eAlliance program demonstrates a low-cost and high-reward intervention that is easily implementable to assist women and parent academics in STEM.

Keywords: STEM women faculty; peer mentoring; COVID-19 impact

¹ Authors with a superscript of 1 are affiliated with Carleton College; authors with a superscript of 2 are affiliated with North Carolina State University; authors with a superscript of 3 are affiliated with the American Association of Physics Teachers; authors with a superscript of 4 are affiliated with the Center to Advance Research and Teaching in the Social Sciences; and authors with a superscript of 6 are affiliated with the University of Puerto Rico.

Contact Cindy Blaha  cblaha@carleton.edu  Carleton College, Northfield, MN 55057

Contact Beth A. Cunningham  bcunningham@aapt.org  Chief Executive Officer, American Association of Physics Teachers, One Physics Ellipse, College Park, MD 20740

Women have always been underrepresented in STEM fields of academia. There have been many suggested reasons for this: it has been proposed that women have smaller brains, are less skilled at mental spatial rotation, or less interested in technical ideas. The “chilly climate” in science has been blamed, as has an educational system that is unfriendly to women (Hall & Sandler, 1982). Some scholars have suggested that women’s responsibility for household work and childcare are important reasons for women’s lack of progress in science (Ivie & Tesfaye, 2012).

In the nineteenth century, women scientists were expected to resign from professional positions upon marriage. Harriet Brooks was famously forced to resign from the physics department at Barnard when she became engaged.

Dean Laura Gil said, “The College cannot afford to have women on the staff to whom the college work is secondary; [yet] the College is not willing to stamp with approval a woman to whom self-elected home duties can be secondary” (Rossiter, 1982, p. 16).

Even well into the twentieth century, the culture of science was unfriendly toward women’s family responsibilities. Many well-known women scientists were unmarried (Barbara McClintock or Gertrude Belle Elion, for example). Women who did have children often had considerable family help (Marie Curie, for example) or came from social strata that allow substantial household help (Maria Goeppert-Mayer, for example). Stories abound of Cecilia Payne-Gaposchkin’s children running wild through the Harvard College Observatory (McGrayne & Mielczarek, 1993).

Throughout most of the twentieth century, women remained significantly underrepresented in most STEM fields, to a great extent due to family responsibilities. In 2004, Sue Rosser interviewed women scientists about challenges to their careers; “balancing career and family” was mentioned more than twice as often as any other statement (Rosser, 2004, Table 9). Studies show that women experience a “baby penalty” with negative impacts on their academic careers, whereas having a child positively impacts the careers of men (Mason, 2013, 2014; Mason & Goulden, 2002, 2004). In 2019, Porter and Ivie reported that women were far more likely than men to have slowed down their professional advancement for family reasons; women were 346% more likely than men to have declined a job for a spouse, 400% more likely to

have had a career break for family reasons, and 463% more likely to have become a stay-at-home parent (Porter & Ivie, 2019, Table 11).

Along with the mid-twentieth century women's movement and the Civil Rights Act of 1964, the situation of women began to improve slowly. Universities and colleges began to modify the worst of policies like anti-nepotism. Higher education became slightly more family friendly. Funding agencies like the National Science Foundation (NSF) developed programs to bolster women scientists' success. The number of women in STEM began to rise; in 1970 women received 3% of PhD's in physics, by 1990 the percentage increased to 10%, and by 2016 it had reached 20% (Porter & Ivie, 2019, Figure 1). Although slowly increasing, the percentage of women of color in physics remains low (Ivie et al., 2014), and the challenges of navigating both race and gender issues persist (APS Webinar, 2024, Ong, 2023). Women's representation increased in academic and in leadership positions; Rita Colwell became the first woman director of NSF, and in 2018, Donna Strickland became the third woman to win the Nobel Prize in physics.

Given this progress, the effect of the COVID-19 pandemic on women's academic careers is particularly discouraging. The pandemic caused difficulties for all men, women and gender non-binary academics, who struggled to develop new methods of teaching online with no preparation time. However, given societal gendered expectations, women faced greater burdens. With public schools and day care centers closed, women were forced to try to remain professional while teaching classes with toddlers on their laps. Women professors often had to balance monitoring their own children's schoolwork with the needs of their students and the academic classes they were teaching. Already bearing more than their share of advising (Ivie & Tesfaye, 2012), women struggled to meet the overwhelming demands of anxious and depressed students during the pandemic. Many also struggled with toxic departments (Fairchild et al., 2018). In this climate, exhausted and demoralized women were forced to put their research on hold, potentially damaging their career prospects for years to come. The effects of the pandemic disrupted the progress that women had been making in science.

While the responsibilities of academic physicists include teaching, mentoring and service, it is generally research and scholarship that determine career advancement in

most institutions of higher education. In this context, the effects of the pandemic were especially difficult for women. Multiple reports show that research stoppages and reductions as a result of COVID-19 have resulted in a loss of ground for women (Malisch et al., 2020; Myers et al., 2020; National Academies of Science and Engineering (NASEM), 2021).

In addition, there was a large increase in the time required to advise, support, and accommodate students during the pandemic (Krukowski et al., 2022; NASEM, 2021). This was particularly true for women with young children (Krukowski et al., 2021; Yildirim & Eslen-Ziya, 2021) and women faculty of color (Berheide et al., 2022). Adding to the gendered expectation of women faculty as caring and nurturing mother figures, many women faculty members described the greater concern of advising students during COVID-19 when student mental health issues became epidemic (Salimi et al., 2021; Son et al., 2020).

In this paper, we present quantitative and qualitative data that document the negative effects of the pandemic on the careers and lives of women faculty in physics and astronomy, particularly parents of young children. We also document one low-cost intervention that provided some support for women during pandemic lockdowns: participating in a distributed peer mentoring network, or eAlliance; that is, participating in a mutual mentoring group in which the members are at different institutions.

About eAlliances

Using funding from the NSF PAID ADVANCE program, principal investigators created the eAlliance project (2015-22) with support from the American Association of Physics Teachers (AAPT). The eAlliances were distributed peer mentoring networks designed to support the professional advancement of women physicists and astronomers and ameliorate their isolation (Hunter et al., 2024). eAlliances are based on a mutual mentoring model, which has been shown to mitigate toxic environments by 1) sharing leadership responsibilities and privileges (Fairchild et al., 2018) and by 2) providing support and advice from peers outside their own institution (Karukstis et al., 2010). This distributed structure provides “safety at a distance,” allowing group members to share both professional and personal issues without fearing the politics and

consequences that may accompany traditional departmental and institutional faculty mentoring and professional development programs.

Forty-nine participants were matched to 11 eAlliances based on a variety of professional and personal characteristics. The eAlliance project was promoted through national meetings and newsletters aimed at the physics and astronomy communities. Interested women academics signed up at the eAlliance website and identified the professional and personal characteristics they wished for in a peer mentoring network. Participants were matched into eAlliance cohorts by the project's mentoring algorithm or organized by the project team leaders, who then managed the cohorts throughout the program. Further details about the eAlliance project may be found in Hunter et al. (2024). The eAlliance participants represented women physicists and astronomers from the range of U.S. postsecondary STEM institutions (i.e., large PhD granting institutions, small liberal arts colleges, two-year colleges, etc.) and spanned career stages from new hires to senior faculty. Most often, group members of an eAlliance were at the same career level and working at institutions of the same type, but some groups held little in common by these criteria and were equally successful. Most of the eAlliance participants met initially in-person at professional meetings, followed by regular electronic meetings once or twice a month, or more depending on members' preferences. One group was successful in meeting asynchronously using a Google Doc to record members' feedback, support, and advice. Most groups used multiple means to stay in touch, including texts and other social media apps. These eAlliances formed prior to the COVID-19 pandemic in 2020 and these cohorts proved to be particularly helpful in supporting members throughout the pandemic.

Prior to COVID-19 lockdowns, eAlliance participants discussed a wide variety of topics in their groups (Hunter et al., 2024), including professional choices, navigating new experiences, family, and work-life balance. Depending on the career level and institution type, different eAlliances gravitated to different topics. A pre-tenure group had focused their meetings on scholarship and professional development with the aim towards their tenure packages. A two-year college group supported each other about student interactions and pedagogical strategies. For many groups, the line between professional and personal became less defined, as issues with family or colleagues

surfaced during meetings. What is apparent is that the eAlliances spoke on many topics, but with the grounding of mutual support by sharing resources and advice, providing a 'safe space' and non-hierarchical structure for members of an eAlliance.

Methods

In order to assess the effects of the eAlliances on participants, the Statistical Research Center at the American Institute of Physics (AIP) surveyed the participants as part of a larger sample survey of physics and astronomy faculty members. Approximately every five years, the AIP administers the Faculty Member Survey. The survey focuses on the demographics, training, and experiences of faculty members. In the 2021 survey, the Statistical Research Center included a special section on the impact of the COVID-19 pandemic (Walsh & Tyler, 2022). Including the project participants in the larger survey enabled comparisons between eAlliance participants and non-participants. The larger faculty member survey was first conducted in 2016 and did not include the eAlliance participants. The survey was conducted again in 2021 and included questions designed to measure the effects of the pandemic on faculty members. Because some of the same questions were asked in 2016 and in 2021, the AIP surveys allow a unique comparison of faculty members' experiences before and after the pandemic.

In both 2016 and 2021, AIP drew a random sample of 286 degree-granting physics and astronomy departments in the United States and surveyed all faculty members, including contingent faculty members, at these departments. Faculty members at all degree-granting physics departments at Historically Black Colleges and Universities were included in both surveys. Physics and astronomy faculty members from two-year colleges were not included in the regular Faculty Member Survey since they are surveyed on a less frequent basis.² In 2021, all participants in the eAlliance

¹The most recent survey of Two-Year College (TYC) faculty was done in 2023 by AIP for the OPTYCs (Organization for Physics at Two-Year Colleges) program. It revealed that 26% of Full-Time TYC faculty were women and that women made up 29% of Part-Time TYC faculty. (Chu et al., 2025).

project were surveyed and this included our eAlliance members at two-year colleges. In the 2016 survey, 1945 faculty responded and in the 2021 survey, 1248 faculty responded. In terms of gender breakdown, for the 2016 survey 19% of the respondents were women, 79% were men and 2% chose "Prefer not to respond". For the 2021 survey, 23% were women, 77% were men and 0.5% chose "another gender". A total of 28 eAlliance members responded to the 2021 survey.

The data presented here are the results of statistical analyses that show the differences between men and women faculty members in physics and astronomy.³ All gender differences reported are statistically significant in multivariate models controlling for faculty rank, citizenship, race/ethnic identity, highest degree offered by department, public/private institution, type of department, highest degree, years since highest degree, and department climate. Using the 2021 data, AIP also conducted analyses to determine whether the eAlliance participants were different from other women respondents, but there were no statistically significant differences.

In addition to the quantitative data from AIP, we also have qualitative data from 41 of 49 participants in the eAlliance project, which ran from 2015-2022. For the summative evaluation of the initiative, 35 of 49 participants (71%) were interviewed by Zoom electronic conferencing between February and April 2022 to learn how the COVID-19 pandemic had affected them professionally and personally; this was following the worst of the pandemic, but amid the new turmoil caused by the Omicron variant outbreak. We also collected online journal responses (eJournals) to prompts about the project itself. The last three (of five) eJournal questionnaires were expanded to include questions on the impacts of the pandemic and to assess the extent to which

These percentages are similar to the 2024 survey results for four-year colleges and universities where 21% of physics faculty were women and 25% of astronomy faculty were women (Porter et al., 2025).

² When the eAlliance project began in 2015, all participants identified as women; however, by the end of the grant a few of the participants identified as gender non-binary. In the AIP questionnaire, participants had 3 choices for gender identity: "1) man; 2) woman; 3) another gender." Because there were so few people who identified as "another gender", they were not included in the quantitative analysis shown here.

participation in the distributed peer-mentoring networks supported faculty during the crisis. Overall, in addition to interviews with a majority of participants, 46 eJournals were collected from 22 of initiative participants (45%) collected between January and August, 2022. Triangulation of the qualitative and qualitative data provide a check for the validity and reliability of our results.

Rooted in the theoretical work and methodological traditions of sociology, anthropology, and social psychology (Berger & Luckman, 1967; Blumer, 1969; Garfinkel, 1967; Mead, 1934; Schutz & Luckman, 1974) qualitative and ethnographic methods are particularly appropriate for research in contexts where existing knowledge is limited and to uncover tacit knowledge and taken-for-granted assumptions (Creswell, 1994; Glaser & Strauss, 2017). Classically, qualitative and ethnographic studies precede survey or experimental work because they can identify and explore beliefs, attitudes and rationales shaping informants' actions while also accounting for the complex social and cultural systems shaping peoples' experiences and beliefs. Our goal in this work was to use qualitative methods to understand women physics and astronomy faculty's lived context.

The ethnographic method for developing the interview protocols and eJournal prompts, as well as the analysis of the text data, follow procedures originally described by Spradley (1979). Spradley, in contrast to more traditional ethnographic approaches, emphasized the importance of understanding how people interpret and give meaning to their actions and experiences (Selig, 1992; Spradley, 1979). Spradley's work stressed a structured approach to analysis known as "developmental research sequences," which build meaning and understanding based on systematically coding and categorizing data based on the participant's viewpoint (Spradley, 1979). Thus, Spradley's ethnographic approach provides a method whereby researchers, through systematic interviewing and analysis, can uncover, understand, and describe culture and meaning from the informant's perspective.

Following Spradley's systematic method of analysis, some codes were generated deductively, based on themes from previous research on distributed peer mentoring, or to capture issues important to the program evaluation (Hunter, 2014; Karukstis et al.,

2010). Codes were also generated inductively, based on new issues that were raised by participants in describing the impacts of COVID-19 on their professional and personal lives (e.g., the sudden switch to online learning, challenges of learning new technology necessary for remote teaching, the isolation of remote teaching or being in quarantine, issues with childcare or eldercare, attending to student anxiety, etc.). Codes were organized hierarchically within domains that represent the larger categories of interest in the study (e.g., the impacts of COVID-19, concerns about teaching post-COVID-19, institutional responses to COVID-19, unforeseen benefits of COVID-19, work and health status of participants during COVID-19). Like individual codes, some domains were created deductively with reference to prior research findings, but almost all codes within each domain were inductively grounded in issues spontaneously raised by interviewees.

Ethnographic analysis proceeds by coding each segment of textual information on any matter that speakers identified as significant to their experiences. Although the protocol questions (also deductively derived from previous research findings) initially framed the topics of discussion, it was always what interviewees raised as relevant in response to any question or wrote in response to an eJournal prompt that determined into what existing code category any response was placed or whether a new code was needed to capture an idea raised by the interviewee's response. Thus, more than is the case in content analysis, ethnographic analysis proceeds by coding each segment of text as a piece of evidence that the speaker has identified as significant. Because normal conversations and written comments often reference different matters in the same few sentences and may be layered by observations of different kinds, any segment of interview text is apt to contain several distinct ideas, each of which is coded with a separate code name and may be placed in different domains from other utterances in the same segment. For instance, a question like, "How did the COVID-19 pandemic affect you professionally?" is apt to solicit a response that references teaching, their institution, students, issues with technology, problems with child or elder care, and so on: these are each captured and categorized in relevant domains.

NVivo 12.0, a qualitative software program that allows for the multiple, overlapping, and nested coding of a large, complex volume of text data, was used to

code both the interview data and eJournal entries (QSR International, 2022). As coding of the interview text files and eJournal responses proceeded the emergent codes and codebook were continuously refined and evolved to ensure participant responses and meaning were correctly and completely captured. When the coding process was concluded, frequencies were run for code clusters across the whole data set. Both individual codes and broader domains grounded in themes that had emerged in the interview data were analyzed for any patterns by sub-group (i.e., early or late career, discipline (i.e., physicists vs astronomers) and race/ethnicity (Boyatzis, 1998; Creswell, 2012). Overall, the qualitative data showed important supportive roles that mutual mentoring played during the tumultuous pandemic lockdown period.

Results

To get a sense of the size of the resulting final electronic code book, the ethnographic analysis of verbatim interview transcripts concerning only the impacts of COVID-19 (that is, not inclusive of discussion regarding issues relevant to the summative program evaluation, (i.e., advice for program improvement, sustainability and replicability, factors critical to program success, etc.) generated 7 major domains; 15 sub-domains, 107 discrete codes, and a total of 813 individual observations (see Table 1). The ethnographic analysis of the last three eJournals concerning only the responses about the impacts of COVID-19 generated two major domains, 2 sub-domains, 87 discrete codes, and a total of 181 individual written comments (see Table 2). The numbers generated in these two frequency tables offer a sense of the breadth of issues, as well as the relative weight of particular participant observations on the impacts of COVID-19.

Table 1

Summative Interviews: Overview of COVID-19 Topics Discussed

Observation	N Files	N Obs.	Total N	% N
<i>Impacts of COVID-19</i>				
<i>Professional</i>				
Teaching	35	225		
Research	35	42		
Collaborations	23	23		
Tenure and promotion	19	25	315	39%
<i>Personal</i>	35	153	153	19%
<i>Post-COVID-19</i>	35	94	94	12%
<i>Benefits of COVID-19</i>	35	76	76	9%
<i>Institutional responses to COVID-19</i>	35	62	62	8%
<i>Importance of eAlliance during COVID-19</i>	24	45	45	6%
<i>eAlliance meetings during COVID-19</i>	24	45	45	6%
<i>Health and work status during COVID-19</i>	17	23	23	3%
Totals	35	813	813	100%

Table 2

Summative eJournals: Overview of COVID-19 Written Responses

eJournal Observation	N Files	N Obs.	Total N	% N
<i>eJournal 3</i>				
Importance of eAlliance during COVID-19	13	25		14%
Impacts of COVID-19	13	72	97	40%
<i>eJournal 4</i>				
Importance of eAlliance during COVID-19	10	16		9%
Impacts of COVID-19	10	42	58	22%
<i>eJournal 5</i>				
Importance of eAlliance during COVID-19	23	23		13%
Impacts of COVID-19	3	3	26	2%
	46	181	181	100%

Overall, 60% of all participant comments from summative interviews described the professional and personal impacts of COVID-19, with remaining comments discussing what teaching might look like post-COVID-19, the benefits of COVID-19, institutional responses to COVID-19, the importance of eAlliance support during COVID-19, eAlliance meetings during COVID-19 and participants' health and work status during COVID-19 (see Table 1). As the summative eJournal responses indicate, participants

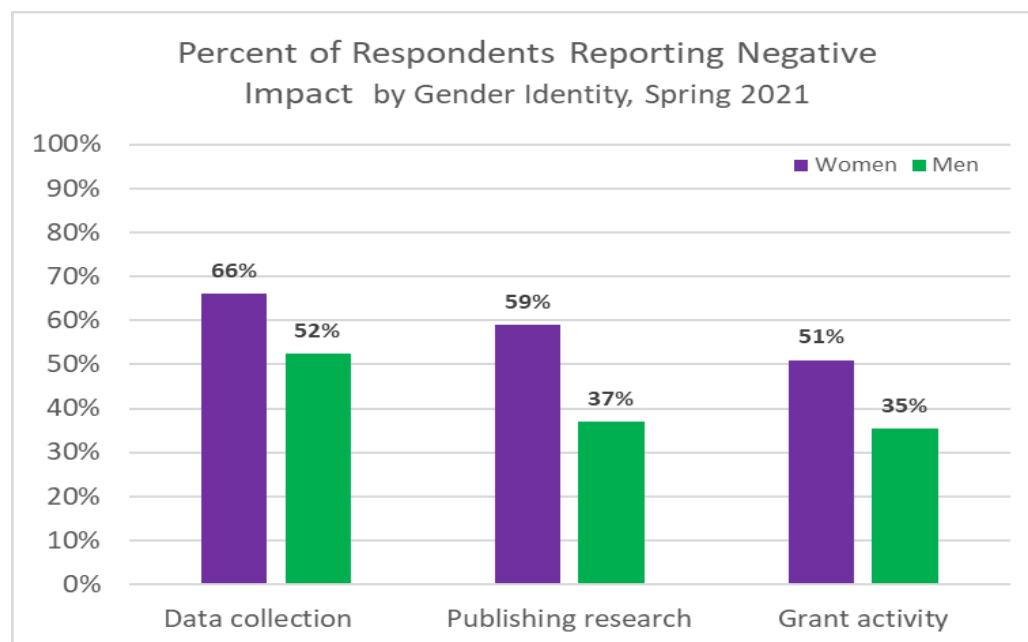
underscored the impacts of COVID-19 at the outset of the pandemic, but over time, emphasized the importance of their eAlliance's support during COVID-19 (see Table 2). Throughout this article, quotations from summative interviews and eJournals are used to illustrate the ways in which the COVID-19 pandemic impacted project participants and testify to the beneficial and critical support offered by the members in their distributed-peer mentoring group.

Research and scholarship

The 2021 AIP survey measured faculty members' perception of the effects of the pandemic. As Figure 1 indicates, a greater percentage of women than men reported that the pandemic negatively affected their data collection, publishing, and grant activity; that is, their research and scholarship, the mainstay of an academic career in physics.

Figure 1

Percent of respondents reporting negative impacts due to COVID-19, compared by gender identity. Data were gathered in Spring of 2021



Similarly, in interviews and eJournal responses, participants were clear in stating that their research was “the first to go” during COVID-19: the unexpected, rapid pivot to remote teaching, the sharp increase in students needing accommodations and

struggling with their mental health, working from home and trying to manage both the professional and personal in the same space, could all be overwhelming; there simply was no additional capacity for research. In contrast, prior to COVID-19 lockdowns, research was often a topic discussed in eAlliance meetings.

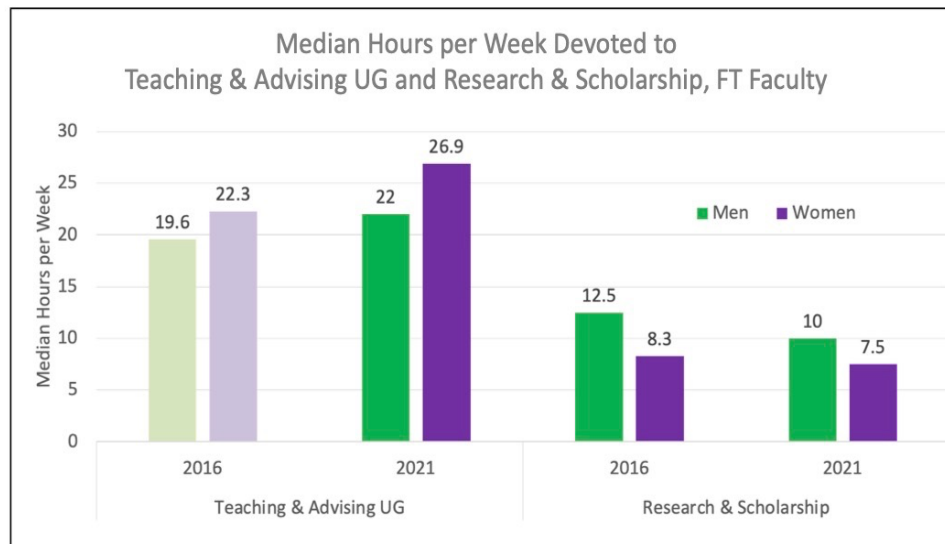
My university shifted to online teaching pretty quickly, and [classes] are almost fully online for the fall [of 2022]. Luckily I have a light teaching load and I am tenured, but I definitely had to step away from my research group even more than when I had [to stay away] with two young kids. (eJournal 3, eAlliance C)

The shift to online teaching has taken lots of time that I didn't have or plan for. At the same time, my children required more attention from me for homeschool and in the summer because their camps were all cancelled. I had to curtail a number of research and teaching projects I planned for this year, but since I just made full professor, I just did that. Honestly, I nearly had a nervous breakdown managing all of this, but now that I have found a reliable childcare situation, that is helping a lot. (eJournal 3, eAlliance B)

Comparing the 2016 survey data to the 2021 survey data shows that faculty member's perceptions of less time for research are supported by differences in time use before and after the pandemic. Women reported spending less time doing research than men did, both in 2016 before the pandemic and in 2021 (Figure 2). The data shown in muted color indicate no statistically significant differences between women and men but are included for completeness. While women statistically spent less time on research in both survey years, participant interviews revealed that "research was always the first to go" during the pandemic.

Figure 2

Median hours per week devoted to teaching and advising undergraduates and research and scholarship from the 2016 and 2021 surveys. Data include full-time faculty only. The data shown in muted color indicate no statistically significant differences between women and men but are included for completeness.



Teaching and advising

The 2016 and 2021 AIP surveys also asked faculty members to report the time spent on teaching and advising undergraduate students. Figure 2 shows that, before the pandemic in 2016, there was no statistically significant difference between men and women in the total number of hours they devoted to teaching and advising, but during the pandemic, women spent more time teaching than men.

It is difficult to understate the immense stresses and strains that the COVID-19 pandemic imposed on faculty members' teaching. For most, the sudden shift to remote teaching was a tremendous task requiring huge effort. The following quotation is typical of participants' experience:

There was a huge sense of shock when we went into lockdown. And it was like a bomb goes off in your life because you had all your classes set up, everything planned for your semester, and then you throw out the entire thing and start over. And you're starting over in all your classes simultaneously with no prep time and not knowing the technology and not having a game plan because nobody has tried to teach labs virtually before. So, you're making up everything as you go along and you're just

drowning in that environment. I think all of us shared that we felt like we were just trying to get to the end of the semester, and it was treading water and you did feel like you were drowning. (Interview, eAlliance J)

Participants in eAlliances described the additional time required to advise, support, and accommodate students during the pandemic. They experienced heightened concerns related to advising when COVID-19 exacerbated student mental health issues.

I think especially as women faculty...we're often sought out as advisors. Not just for academics, but also for emotional wellbeing and how people are doing. And so there's been a lot of trying to deal with student stresses and trying to alleviate their anxieties and that's a whole lot of extra emotional labor on our part. (Interview, eAlliance D)

I have an awful lot of students that are literally on the edge. And I'm not prepared to handle students who are that level of mental health issues. And it's not just one or two. So everything about my class is flexible. Being that flexible all the time with everyone is exhausting. There's not anything left of me to give. And I've noticed that my female [sic] colleagues are in similar positions. The male [sic], I'm sure, as well. I just don't happen to talk to them about that kind of thing, but I feel like there's a heavier burden on some. (Interview, eAlliance E)

Figure 2 and these quotations highlight that student interactions require more time (and presumably, effort) for women than men when there is a crisis, such as during a pandemic. While no statistical difference between women and men was seen prior to COVID-19 lockdowns, the quotations indicate that women bear a greater burden for emotional labor.

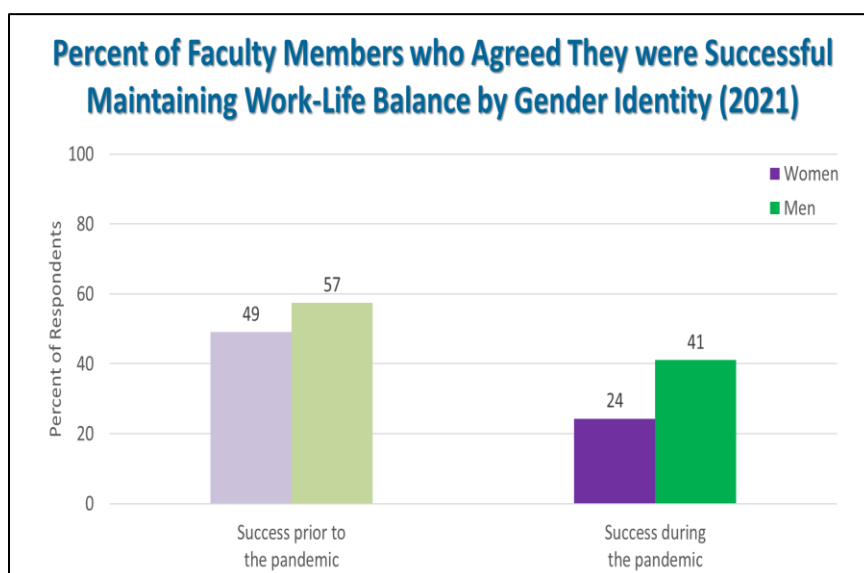
Work-life balance

In both 2016 and 2021 AIP asked faculty members whether they felt they were

able to maintain a successful work-life balance. Before the pandemic, there was a difference in percentage between men and women, but it was not statistically significant. However, during the pandemic, the difference is statistically significant, and points to the fact that women were much less likely than men to report maintaining a successful work-life balance (Figure 3).

Figure 3

Percent of faculty members who agreed they were successful in maintaining work-life balance, compared by gender identity. Success prior to pandemic refers to 2016 and success during the pandemic refers to 2021. The data shown in muted color indicate no statistically significant differences between women and men but are included for completeness.



Managing the overload of teaching remotely and the increased time spent advising students during the pandemic necessarily meant a reduction in time spent on research, as we have noted. Participants in the eAlliances described how COVID-19 obliterated any measure of work-life balance for women faculty.

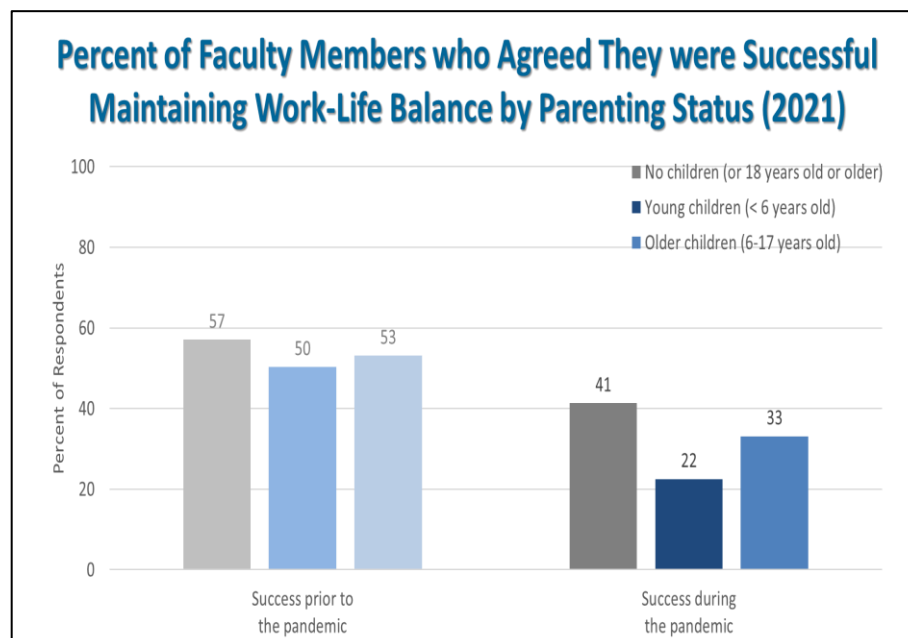
I have been pretty successful at work, though my work/life balance has tanked during COVID. (eJournal 4, eAlliance B)

There was no 'balance' between personal and professional life this year. I worked virtually every day (7 days/12 hrs/day) during the pandemic except for a few 'collapse days.' There was no differentiation between professional or personal. I addressed whatever was most on fire. Everything was on fire. (eJournal 4, eAlliance E)

The AIP survey data also show that the pandemic affected work-life balance differently for parents than for non-parents (Figure 4). In 2016, about half of faculty members reported a successful work-life balance regardless of parental status (differences shown for 2016 are not statistically significant). However, in 2021, the data showed a statistically significant difference: parents of young children (less than six years old) were much less likely to report a successful work-life balance than parents of older children and than faculty members who were not parents.

Figure 4

Percent of faculty members who agreed they were successful maintaining work-life balance, compared by parenting status. Success prior to pandemic refers to 2016 and success during the pandemic refers to 2021. The data shown in muted color indicate no statistically significant differences between parenting status but are included for completeness.



The pandemic heightened the tremendous pressure placed on all parents as they tried, somewhat unsuccessfully, to balance childcare responsibilities with faculty responsibilities. The eJournal entries and interview responses of our eAlliance participants revealed that it was particularly hard for mothers. Without childcare for young children, parents really struggled.

I've been working to 1am or 2am in the morning many, many mornings, and I still do get up at 6am with my kids. (eJournal 4, eAlliance A)

Given cultural expectations placed on women as caregivers and the increased number of hours women spent teaching during the pandemic, this gender difference is perhaps not surprising and is another indicator of the problems faced by women faculty members during the pandemic. The following quotation portrays this common outcome all too clearly as this eAlliance.

A Participant described prioritizing her husband's job over her own as a practical matter when covering professional responsibilities and childcare during COVID-19.

So when [the pandemic] started, my youngest son was 18-months old and my oldest had just turned four.... My kids were home full-time, I had to figure out how to teach online, and my husband had a full-time job.... So we built schedules around my class periods, and we had a big schedule on the wall that had activities for the kids.... We'd wake up at 7am, and we'd start our work shift. One of us would start working at 7am, and we'd go on and off, and we could both get in six-hour days, in theory, if we worked from 7am to 7pm in shifts. And that's what we did. And we did that until May.... And I remember at the end of it, getting through the semester, just having one of those hyperventilating cry sessions on the kitchen floor with, 'I just need it to

be summer. I can't keep doing this. I'm so tired.'... During the school year, we prioritized my husband's job because I'm tenured, and there's no way they're going to fire me for a pandemic. But we didn't want to risk his job. He makes more than I do, and it's less of a guaranteed job.... We would try and get him at least a 30-hour week, and mine was closer to 25. Our most recent childcare loss, I took a partial leave of absence in the fall.... And then I took a leave of absence from my winter class, because we teach an intensive term...and there's no way I could do it if one of my kids was sick.... The problem now is that I'm so burned out, and I'm so behind on things. (Interview, eAlliance J)

Cultural expectations for care-giving places a greater onus on women, and COVID-19 lockdowns highlighted this disparity by women prioritizing teaching, student well-being, and childcare over research more than men.

eAlliance Benefits

Our results show that COVID-19 had multiple, varied impacts on interviewees' professional and personal lives. By their own accounts, the sudden switch to remote learning at the onset of the pandemic was exhausting, requiring long hours and late nights to revamp courses. One recent study found that faculty overwhelmingly turned to "other faculty in my department" for support during the switch to on-line teaching (Brewer et al., 2021). For eAlliance members who reported feeling isolated or experiencing a hostile work environment in their departments, this type of support was not readily available. Our eAlliance interviewees uniformly reported that teaching online and accommodating students required much more work than teaching in person. There was no balance between their professional and personal lives: COVID-19's impacts were wholly consuming. While participating in the eAlliance initiative brought a range of professional and personal benefits, nearly 70% of those interviewed about their experiences during COVID-19 emphasized that their eAlliance was a tremendous source of support during the pandemic (Hunter et al., 2024).

Mainly, participants were grateful to have others who understood the difficulties of being a physics or astronomy faculty member at the time of the pandemic. They were relieved to belong to a group where members could relate to the overwhelm wrought by the “pivot” to remote teaching. Group members shared helpful tips and resources and appreciated others’ encouragement when needed. At times, the group provided a sympathetic listening board where members could simply commiserate about how hard life was during COVID-19.

Definitely helpful in sharing ideas and problem-solving during remote teaching and COVID-19 impacts. And when there wasn't anything to be done about a situation, just having people to listen empathetically has been really useful. (eJournal 4, eAlliance E)

During the COVID pandemic the eAlliance was a lifeline. My group provided validation, support, and encouragement. It really was a balm to my burnout! (eJournal 5, eAlliance J)

For some, their eAlliance was important in helping to alleviate the isolation imposed by working from home and COVID-19 quarantines. Some groups increased their meeting frequency to help.

These [women] are also the only adults outside my immediate family that I get to consistently chat with during this pandemic time, which has been so nice at warding off the isolation that I know many people feel. (eJournal 4, eAlliance D)

Prior to the pandemic, I did not feel isolated. Once we pivoted to remote teaching and work in Spring 2020, I felt incredibly isolated. I interacted synchronously with my students (many just blank tiles, aka teaching into the void) during class and office hours, but I had very little interactions with my colleagues other than Zoom department

meetings. Having my eAlliance friends was a godsend. (eJournal 5, eAlliance E)

Several women commented that their eAlliance was particularly important in providing permission to not be everything to everyone and to focus on self-care during the pandemic. The following quotes from two different women in the same eAlliance illustrate how tremendously grateful participants were for the support, advice, feedback and perspective that was offered by their eAlliance group members during the pandemic.

My eAlliance has been super supportive. They all have young children and so we are all in the same boat. It is nice to see that I don't have to be Super Woman. I can just take care of my kids and teach and not do any scholarship and that is okay. That is just what I have to do right now, and that is enough. (eJournal 3, eAlliance A)

Right now I just can't do it all, or even any approximation to it all. So when that is the case, the question is, 'What do you not do?' Those are questions that are really awkward to ask my other colleagues. It's awkward to say, 'Well, can my teaching be a little bit less stellar this semester? Can I scale back my service?' But those are exactly the kinds of crucial questions we've been talking about in our eAlliance this season. It is helpful to see what other people aren't doing, and it makes it easier for me to let some things go, as well. (eJournal 3, eAlliance A)

While the support, advice, feedback, and perspective were present for eAlliances prior to COVID-19 lockdowns, during the lockdowns having this support structure was "lifesaving."

Call to Action

Women continue to be underrepresented in physics. The COVID-19 pandemic made the reasons for this even more apparent. Efforts such as building protective cohorts, like in our eAlliance project, can help combat the isolation that women feel in a highly gendered field. But it is not enough. We need structural changes.

“Do babies matter,” asked Mason and Goulden (2002, 2004)? Indeed, they do, as was made even more obvious during the height of the pandemic. Quality, affordable childcare is absolutely necessary for women in academia to manage their work-life balance as we showed above in the section on work-life balance. Academic institutions can do more by providing affordable on-campus childcare options, underwriting their costs as a necessary benefit for a stable workforce, and turning around the pandemic-accelerated decline in on-campus childcare (Field, 2021; Gluckman, 2023).

When it comes to promotion and tenure, it is essential that institutions recognize the differential impact of the pandemic on women and parents of young children. Furthermore, institutions need to account for the uneven balance of teaching and advising that falls to women and people from other underrepresented groups. Multiple pathways to tenure and promotion are one way forward.

National policies also need to be changed. One particularly antiquated policy is the funding restrictions that flow from the U.S. Office of Management and Budgeting. While NSF, through ADVANCE, funded the eAlliance project and generally supports programs to retain women in STEM, budgeting rules do not allow reimbursement of dependent care expenses as direct costs in any grant program: even those that support conference travel and promote mentoring projects (NSF Form 10-032, 2024). Are the women that NSF supports expected to not have dependents, or to have a partner who is available to engage in full-time dependent care? It should not take a MacArthur grant, as it did for astrophysicist Sara Seager (a decade ago), to continue working (Wall, 2013).

As COVID-19 spotlighted, academia and physics continue to work best for people who already have great privilege and power⁴. We call on you, our readers, to consider the structures and policies currently in place, and their roles in perpetuating an inequitable system. If we want to see sustainable change, we will need those with power to conceptualize, build, and support new structures in the physics and academic realms. Even with structural change, it will take many years for women in physics to regain the progress made prior to the COVID-19 pandemic, and many more before they finally reach equity with men. This is a call to action.

Acknowledgement

This work was supported, in part, by NSF-ADVANCE grant number HRD-1500529.

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⁴ By "privilege and power", we refer to the fact that men make up the majority of faculty in physics and astronomy departments. Women account for only 13% of full professors in these departments (Porter & Tyler, 2024, Table 6).

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Author Biographies

Cindy Blaha is the George H. and Marjory F. Dixon Professor of Physics and Astronomy, Emerita at Carleton College. She received her PhD from the University of Minnesota and has been at Carleton since 1987. Her research focuses on massive stars and the interstellar medium in nearby galaxies. She is active in promoting women in STEM and community, equity and diversity campus initiatives. Cindy's been part of a mutual mentoring network of women physics faculty since 2007 and has served as Co-PI for the NSF ADVANCE grant that created distributed peer mentoring networks to support women faculty in physics and astronomy.

Anne J. Cox is Teaching Professor, North Carolina State University, Department of Physics and Astronomy and Professor Emerita at Eckerd College. She earned her BS in physics from Rhodes College and her PhD in physics from the University of Virginia. She has received local and national awards for her teaching and work in physics pedagogy and served as a co-PI on several NSF grants for teaching and outreach. Her research includes work on interactive engagement methods and mentoring to support women in physics.

Beth A. Cunningham is the Chief Executive Officer of the American Association of Physics Teachers (AAPT). She earned a Bachelor of Science degree, a Master of Arts degree, and a Doctor of Philosophy from Kent State University. In 1989 she joined the physics department at Bucknell University. In 2006, she was appointed as Provost, Dean of the Faculty, and Professor of Physics at Illinois Wesleyan University. In 2011,

she joined AAPT as chief staff officer. She leads several projects focused on increasing diversity in physics including facilitating cultural change in academic departments. Beth is a Fellow of AAAS and APS.

*Anne-Barrie Hunter is Senior Research Associate with and co-director of Ethnography & Evaluation Research, University of Colorado Boulder. For 30 years she has collaborated on research and evaluation projects focused on improving postsecondary STEM education, and initiatives aimed at increasing access and participation of historically minoritized students. Hunter has also acted as PI, co-PI, external evaluator, and consultant for numerous STEM education improvement projects, including HHMI Undergraduate Science Education Program and Inclusive Excellence grants, and multiple NSF ADVANCE awards. She is co-editor and co-author of the 2019 volume *Talking about Leaving Revisited: Persistence, Relocation and Loss in Undergraduate STEM Education*.*

Rachel Ivie is Director of Higher Education Programs and Grants at the American Association of Physics Teachers. Previously, Dr. Ivie worked at the American Institute of Physics, where she served as Director of the Statistical Research Center, then Senior Director of Education and Research, and recently as Senior Research Fellow. Dr. Ivie has a PhD in sociology from the University of North Carolina, Chapel Hill. In 2021, Dr. Ivie was recognized by the American Astronomical Society as a Fellow "For a groundbreaking career of statistical studies tracking important diversity, equity, and inclusion issues in the astronomical sciences."

Kristine P. H. Lui is PI and director for the Organization for Physics at Two-Year Colleges, within the American Association of Physics Teachers. Previously, she taught physics full-time for 12 years, applying student-centered teaching methods. She received her B.Sc. from the University of Guelph, and her Ph.D. from the University of Alberta.

Idalia Ramos-Colón is a professor of physics and electronics at the University of Puerto Rico, Humacao Campus (UPRH). She holds degrees in physics and electrical engineering. Her research is in nanomaterials for optoelectronic devices. She is a fellow of the American Physical Society and principal investigator of a collaborative materials research and education program (PREM) between UPRH and the University of Pennsylvania, funded by the National Science Foundation since 2004. She was the PI for the ADVANCE Institutional Transformation Program at UPRH and Co-PI of ADVANCE-eAlliances, a mutual mentoring program for women faculty in physics.

Barbara Whitten received a BA in physics from Carleton College, and a PhD from University of Rochester. She is Professor Emerita at Colorado College, where she taught in the Physics Department, as well as in the Environmental Science and Feminist and Gender Studies Programs. Previously, she worked at Miami University and Lawrence Livermore National Laboratory, where she was a member of the first x-ray laser team. Her research is in diversity in physics, and in atomic and molecular physics. She is a fellow of the American Association of Physics Teachers, and in 2018 she received the Oersted Award from AAPT.