PROJECT SUMMARY

Overview:
The Arizona State University (ASU) charter states the institution “is measured not by whom it excludes, but by whom it includes and how they succeed.” This charter is built from a public values-based institutional design, which employs design thinking at all levels of the institution to enact policies and practices that forward goals in the public interest. The ASU ADVANCE project will extend the ambition of the ASU charter to faculty through a public-values institutional design by requiring ASU leaders to consider equity and inclusion in every decision that affects faculty. In doing so, participants will increase the diversity of the professoriate in STEM fields at all levels of the university, including in faculty ranks and in varied leadership positions. To carry out this institutional transformation, ASU ADVANCE will:

Initiative 1: Ensure that faculty and administrator procedures on recruiting, promotion, evaluation, and retention explicitly address how to improve equity and diversity in an interdisciplinary structure.

Initiative 2: Provide appropriate and accessible professional development and mentoring opportunities for STEM women and members of underrepresented groups across the entire academic life course.

Initiative 3: Design, implement, and evaluate digital administrative systems to monitor equity-related processes, and empower administrators to intervene to ensure equitable opportunities and outcomes.

Each initiative aims to consider how intersectional dynamics affect and are affected by the explicitly interdisciplinary environment of ASU. A professorship constitutes a long-term relationship with an institution; ASU ADVANCE takes a life course approach to support professors from the beginning of the career, into the middle, and through to the end. "Intersectional" means the ways in which faculty experiences are shaped by gender, race, ethnicity, foreign-born status, sexual orientation, disability, rank, and discipline, and how those experiences influence opportunities for career advancement and leadership opportunities. "Interdisciplinary" means the ways in which ASU encourages and structures interdisciplinary scientific work, including the STEM fields, at the individual, project, unit, and university levels. The social science research plan uses a mixed-methods approach to interrogate how intersectionality and interdisciplinarity work together to structure the academic life course.

Intellectual Merit:
Interdisciplinary research provides opportunities for academics at the same time that academic institutions continue to foster barriers to full participation in academic life by members of many groups. ASU is a strategic research site uniquely well-suited to study how diverse faculty experience and navigate an explicitly interdisciplinary research environment across the academic life course. ASU ADVANCE will enable the analysis of how known bases of difference in the academic life course - gender, race, ethnicity, sexual orientation, foreign-born status, disability, rank, and discipline - interact with the interdisciplinary context to create opportunities and barriers to academic career advancement.

Broader Impacts:
ASU is a national and international leader in higher education, and is considered by many to be a model of how to provide high-quality accessible higher education to an increasingly diverse United States. Excellence and inclusion are seen as complementary at ASU, which is an idea worthy of export to other institutions of higher education. The ADVANCE initiative will create training and mentoring tools that are digitally enhanced, an approach recognized to reach a diverse range of people, including those living with disabilities. Furthermore, it will develop and employ digitally-based administrative monitoring tools to assess equity in faculty decision making. The dissemination strategy includes convening a regional group of institutions to share best practices related to establishing and maintaining diverse faculty in Hispanic-Serving Institutions.
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Project Description

Arizona State University (ASU) shares many of the challenges facing other research universities in achieving equity among its science, technology, engineering, and mathematics (STEM) faculty. We conceptualize equity broadly to encompass the many dimensions implied by intersectionality in a higher education environment including gender, race and ethnicity, sexual orientation, foreign-born status, disability, rank, and discipline. ASU ADVANCE will transform the institution’s policies and practices to ensure that STEM faculty professionally develop and advance equitably across the academic life course. ASU offers distinct advantages to support this vision: its innovative leadership, its demonstrated success solving other difficult higher education problems, and its scope as one of the nation’s largest universities. Consistent with the ASU Charter, which states, “ASU is measured not by whom it excludes, but by whom it includes and how they succeed,” ASU ADVANCE will institutionalize the principle that equity and inclusion along multiple and intersecting dimensions are the responsibilities of every employee of the university. We will accomplish this transformation through three overarching initiatives:

Initiative 1: Ensure that faculty and administrator procedures on recruiting, promotion, evaluation, and retention explicitly address how to improve equity and diversity in an interdisciplinary structure.

Initiative 2: Provide appropriate and accessible professional development and mentoring opportunities for STEM women and members of underrepresented groups across the entire academic life course.

Initiative 3: Design, implement, and evaluate digital administrative systems to monitor equity-related processes, and empower administrators to intervene to ensure equitable opportunities and outcomes.

As part of these initiatives, we will develop a combination of face-to-face interventions, online professional development activities, and digital monitoring systems to advance these initiatives. We intend for our initiatives to address intersectionality along multiple dimensions, including gender, race and ethnicity, foreign-born status, sexual orientation, and disability. We use a broad definition of interdisciplinarity: “a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more bodies of specialized knowledge...to solve problems whose solutions are beyond the scope of a single discipline (NAS 2004, p. 2).” Interdisciplinarity at ASU is present at individual and team levels, and is further elaborated at ASU through an explicitly interdisciplinary—rather than disciplinary—organizational structure. Our research project will investigate how intersectionality affects the academic life course in an interdisciplinary environment.

ASU has been recognized as the most innovative university for the third year in a row by U.S. News & World Report (2017b). Our operative theory of institutional change is public values-based institutional design, which employs organizational design thinking at all levels of the institution to enact policies and practices that forward goals in the public interest (Bozeman 2007; Bozeman and Crow 2018; Crow and Dabars 2015). Public value theory was developed to emphasize that organizations—particularly public ones such as ASU—need to serve public values, and to be organized to forward identified public values (Bozeman 2007). Such an approach is in stark contrast to “new public management,” which forwards the idea that public institutions should behave like private business; the public values framework asserts that there are a number of public values that cannot be left to the market to accomplish (Bozeman 2007). Public values are embedded in the ASU Charter, which emphasizes ASU’s mission to foster inclusion, access, success, community, and global responsibility. ASU has undergone significant changes using this public values-based institutional design resulting in the following hallmarks relevant to this proposal:

- The public value of interdisciplinarity directed ASU leadership to reorganize disciplinary-based departments to interdisciplinary schools focused on intellectual and social challenges facing the
world, including diversity and inclusion, social transformation, sustainability, global exploration, and human health (Crow and Dabars 2015; Crow and Shangraw 2016).

- The coexistence of excellence and diversity as public values has led to the active recruitment, retention, and graduation of a diverse undergraduate student body that reflects the demographics of our state, the first public research university to do so (Crow 2014). In 2002, four-fifths of ASU students were white; by 2016, half of undergraduates were members of racial minority groups or international students (Crow 2014).
- The public value that higher education should serve as broadly as possible; to that end, ASU invests in high-quality online education (Crow 2013; Crow and Anderson 2014), reaching over 30,000 students; *U.S. News & World Report* (2017b) ranked ASU Online 4th of 1,328 online programs.

ASU ADVANCE will build on ASU’s record of achievements in interdisciplinary reorganization, diversity and access at the undergraduate level, and online education to support and advance STEM faculty at all stages of the academic life course.

**Institutional Context: Data and Problem Analysis**

**Data**

To understand the institutional context for the ASU STEM faculty, we use three primary data sources: administrative personnel and grants management data (Gaughan 2017a), a recent report to the President (ASU Women in Leadership Council 2016), and several discussion/listening sessions with equity groups on campus—including the Faculty Women’s Association (FWA), the Faculty Women of Color Caucus (FWCC), and multiple planning sessions with groups of faculty interested in the ADVANCE initiative (Wentz 2017). We note the administrative data we used to conduct our quantitative analysis do not include data on sexual orientation, foreign-born or disability status, though all of these came up during our qualitative analyses and are incorporated into our research plan. Analyzing the needs assessment shows that in many respects, ASU mirrors both the progress women and other underrepresented faculty have made, and the enduring challenges they face, in achieving full representation in academic science.

In 2017, ASU employed 1,912 full-time tenured and tenure-track faculty, of whom 712 (37%) are women. For the purpose of our institutional analysis, we focus on full-time tenured and tenure-track STEM faculty in our analysis but note that ASU ADVANCE programming will be accessible to other kinds of faculty as well. STEM faculty members largely hold positions in the College of Liberal Arts and Sciences (CLAS) and the Ira A. Fulton Schools of Engineering (FSE), which together represent 42% of ASU faculty. The scope of the focal STEM faculty for this project is therefore quite large: 789 faculty, of whom 231 (30%) are women. Table 1 shows ASU’s distribution of tenured and tenure-track faculty by gender and rank is similar to national averages (NSF 2016), with engineering and natural science faculty being more male, and the social sciences faculty being somewhat more female. Compared to national averages, the CLAS natural and social sciences together have higher percentages of URM faculty than the national averages. The project co-PIs encompass social sciences, natural sciences, and engineering, creating a natural bridge for best practices from social sciences to transfer to the other units.

**Table 1. Full-time Tenured and Tenure-Track ASU Faculty in Engineering, Natural and Physical Sciences, and Social Sciences, by Gender and Rank in 2017**

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<tr>
<td></td>
<td>Assist</td>
<td>Assoc</td>
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<tr>
<td><strong>Engineering</strong></td>
<td>68%</td>
<td>83%</td>
</tr>
<tr>
<td><strong>Natural Science</strong></td>
<td>70%</td>
<td>67%</td>
</tr>
<tr>
<td><strong>Social Science</strong></td>
<td>52%</td>
<td>47%</td>
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ASU (Gaughan 2017a)
Table 2 presents the disaggregation of faculty by race, ethnicity, and gender, important bases of intersectionality. The URM column refers to members of traditionally underrepresented racial and ethnic groups, including African American, Hispanic, Native American, and Hawaiian/Pacific Islander; the “other” column refers to other non-white racial groups such as Asian. Compared to US STEM (NSF 2016), engineering and social sciences at ASU are more ethnically and racially diverse among both men and women; the diversity profile of ASU’s natural scientists is similar to the national distribution. The Phoenix metropolitan area is diverse: 30.9% identify as Hispanic, 5.4% as Native American, 4.9% as African American, and 3.4% as Asian (U.S. Census Bureau 2017).

**Table 2. Full-time Tenured and Tenure-Track ASU Faculty in Engineering, Natural and Physical Sciences, and Social Sciences, by Race/Ethnicity and Gender in 2017**

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<tr>
<td></td>
<td>White</td>
<td>URM</td>
<td>Other</td>
<td>#</td>
<td>White</td>
<td>URM</td>
<td>Other</td>
<td>#</td>
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<tr>
<td>Engineering</td>
<td>57%</td>
<td>7%</td>
<td>36%</td>
<td>205</td>
<td>47%</td>
<td>20%</td>
<td>33%</td>
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<tr>
<td>Natural Science</td>
<td>79%</td>
<td>11%</td>
<td>10%</td>
<td>232</td>
<td>80%</td>
<td>7%</td>
<td>13%</td>
<td>75</td>
</tr>
<tr>
<td>Social Science</td>
<td>69%</td>
<td>25%</td>
<td>7%</td>
<td>121</td>
<td>58%</td>
<td>31%</td>
<td>11%</td>
<td>102</td>
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ASU (Gaughan 2017a)

Analyzing the highest levels of academic and research administration at ASU shows there has been substantial evidence of gender, racial, and ethnic differences. Substantial improvement in leadership diversity has been made in the past 12 months, indicative of ASU’s commitment to dramatic and sustainable institutional change in the domain of equity. When we wrote the pre-proposal (Spring 2017), only one of 13 vice presidents was a woman; this year, four of 14 vice presidents are women. Two of these women are also minorities, as are four of the male vice presidents.

Considering traditional academic leadership opportunities, women remain substantially underrepresented. At ASU, one of six department heads in natural sciences is a woman; in engineering, one of five school directors (co-PI Dai) is a woman. Of 21 deans, six are women (including PI Wentz). Expanding our focus to consider academic leadership opportunities that grow from new and emerging fields of interdisciplinary science, we found that women direct only seven of the 30 major interdisciplinary science centers at ASU (Gaughan 2017a).

**Problem Analysis**

From a prior report and the listening sessions, we learned that women faculty at ASU perceive access to fewer resources, less information, and exclusion from mentoring networks compared to men (ASU Women in Leadership Council 2016; Wentz 2017). In addition to the problems that occur at every stage, professors face different opportunities and challenges across the academic life course. The needs of an untenured assistant professor are not the same as those of an endowed professor taking on a new leadership challenge. In the analysis of quantitative institutional data and qualitative interviews, we identified academic life course stages during which women at ASU are disadvantaged relative to men.

While significant progress has been made at ASU toward gender and racial/ethnic diversity among the ranks of social scientists, we underscore the need for renewed efforts on the part of engineering and natural sciences faculty to ensure diverse hiring. Our research determined that family reasons lead to resignations during the probationary period to tenure, but women are much more likely to leave—and to leave for this reason—than men (ASU Women in Leadership Council 2016). Perhaps due to this differential attrition (i.e., selection) during the probationary part of the academic life course, we observe no gender difference in the transition to tenure and the associate professorship within ASU. During the associate to professor stage, we found the associate professorship is the only career stage during which there is a significant difference in men’s and women’s grants activity (as a PI) at ASU (Gaughan 2017a). Women (compared to men) at this stage receive less encouragement and administrative support in developing proposals (Wentz 2017). Women who have been promoted to professor have taken more than a full calendar year longer to be promoted than men (Gaughan 2017a). These differences stem from 1) unit chairs and personnel committees being less encouraging to women candidates and 2) an
inclination on the part of women to delay going up until “all the Is are dotted and all the Ts are crossed.” Finally, as already noted, women are less likely to move into either traditional or interdisciplinary leadership positions at ASU (Gaughan 2017a). Our needs assessment found that women believe there is a lack of transparency about how these opportunities emerge, they are less likely to think they are prepared to assume such roles, and they are less likely to be recruited to such roles by senior colleagues and upper administration (ASU Women in Leadership Council 2016; Wentz 2017). This is likely related to the dynamic Fox (2015) identified whereby informal networks were the primary means by which information was exchanged among women; in other work, Bird (2011) found that men tended to attribute gender marginalization to individual factors, while women attributed it to structural factors. Our institutional research findings are supported by recent research emerging from other ADVANCE initiatives and related studies that have focused on the importance of the full professor transition in understanding gendered dynamics in the academic career (Britton 2010; Fox and Xiao 2013; Gardner and Blackstone 2013; Gumpertz et al. 2017; O’Meara et al. 2017).

Interdisciplinary work tends to be more valued in terms of number of citations, but interdisciplinary scholars tend to publish less (Leahey et al. 2017). Furthermore, women are more likely to engage in interdisciplinary work (Van Rijnsoever and Hessels 2011). Despite the many advances at ASU in interdisciplinary work, our institutional analysis shows that academic evaluations and advancement remain grounded in traditional disciplinary norms that affect academic career trajectories and outcomes (Klein and Falk-Krzesinski 2017). Participants noted variability in the extent to which unit heads value and support faculty engaged in interdisciplinary work, even if it is valued by the university as a whole (Wentz 2017). This is likely due to previous and remaining cultural challenges of discipline-specific and personal expectations, which have been codified in disciplinary policies and practices. Traditional academic evaluation is a gendered and racialized process that systematically disadvantages women and minority groups (National Academies of Sciences 2007; National Research Council 2010). Furthermore, mounting evidence demonstrates that engagement and rewards from interdisciplinary and collaborative scholarship vary by gender and membership in underrepresented groups (National Science Foundation 2015; Rhoten and Pfirman 2007). As a result, ASU faces two barriers to the advancement of diverse faculty into the later academic career and positions of leadership: 1) gender and underrepresented minorities (URM)-related barriers to advancement that are shared by all American universities; and 2) equity challenges in an interdisciplinary environment still embedded in traditional disciplinary-based reward and promotion systems.

ASU has made strides in developing institutional policies and practices to improve gender equity (e.g., partner accommodations and family leave). We take these successes as our guide for organizational change strategies. For example, our study did not find salary differences between men and women (controlling for discipline), or differences in timing at the tenure decision (Gaughan 2017a). We attribute these equity successes in recruitment and salary to a centralized system that requires every search process to be approved and monitored by the Provost’s Office at multiple points in the process: committee establishment, advertising, developing the list of candidates to invite, campus visits, the hiring decision, and the offer letter. Each of these centralized “check-in” points includes an assessment of equity in the process. Similarly, the timing of the tenure and promotion decision is institutionally determined; the process is carefully supervised by the Provost’s Office from the beginning of the process in the late spring, to the culmination of the process the following spring. We also found ASU to be quite successful in recruiting and retaining members of URM groups. These successes were achieved through greater centralization and monitoring at the upper administration level, and give us confidence that ASU ADVANCE can build on past examples of successful institutional change: We found that centrally monitoring personnel decisions results in more equitable outcomes.

ASU must work in many domains if we are to forward interdisciplinary scholarship while simultaneously ensuring equity and inclusion. This leads to the overarching examination of how ASU’s commitment to institutional leadership in interdisciplinary research and scholarship is reflected in the university’s evaluation and monitoring practices of the academic life course and furthermore, how those evaluation and monitoring practices are gendered and racialized. The ASU ADVANCE interventions will
affect the policies and culture of faculty development and evaluation across the academic life course to reflect the reality of interdisciplinary research here at ASU and in global science more generally. This requires attention to both 1) the challenges of evaluating interdisciplinary work in a largely traditional academic world and 2) understanding how women and members of other underrepresented groups work in interdisciplinary scholarship. To that end, the interventions are focused on helping diverse faculty working within and across units to manage the demands of building an academic career while developing an interdisciplinary research trajectory. The evaluation and social science research study components of the project will add to the knowledge base about organizational transformation in higher education, focusing on interdisciplinary science and its relationship to faculty diversity and inclusion.

In sum, ASU faces many of the same equity challenges in the STEM fields as other research-intensive universities across the US. ASU’s equity challenges and opportunities are related to size, its dynamic leadership, the speed of organizational transformation, and its innovative approach to fostering interdisciplinary scholarship. We believe ASU ADVANCE will be instructive to other public research universities, particularly those seeking to enhance their access missions, to encourage interdisciplinary research and teaching, and to invest in professional development across the academic life course. Together, our proposed initiatives advance the public value that equity and inclusion along multiple and intersecting dimensions are the responsibilities of every employee of the university.

Project Activities

The Academic Life Course forms the organizing framework for implementing and evaluating the three ASU ADVANCE initiatives. Scientists have used a life course framework to study academics for some time (Bozeman et al. 2001; Britton 2010; Fox and Colatrella 2006; Gaughan and Robin 2004; Hermanowicz 1998, 2010; O’Meara 2015; O’Meara et al. 2008; Thomas et al. 2015; Zippel 2017). We use this strategy in structuring the institutional analysis, how we develop the interventions, and how we design our research plan. While we envision an academic life course with multiple intersecting pathways, during the early phase of the academic life course, the road is narrow, emphasizing research, teaching, and service excellence required for the path to tenure and promotion. Associate professors are expected to increase their service roles, teach and mentor to higher expectations, and extend their research portfolios. Simultaneously, the expectations and timeline for the next promotion are vague, mentoring can drop off or disappear, and premature concentrations of service could cut off options for the next promotion. Life as a full professor also has its own challenges as faculty navigate pathways toward an expanded view of leadership to include multiple forms such as named professor and non-traditional academic trajectories that include entrepreneurship, civic leadership, or administration (O’Meara et al. 2008). These suggest multiple pathways to leadership excellence, none of which is mutually exclusive. Professors may pursue leadership opportunities in more than one of these pathways over the life course, in some cases, contemporaneously. Our interventions encompass the academic life course, with a particular focus on intervening at problematic points, to prepare diverse faculty to assume varied leadership roles. The social science research component will describe the diversity of successful pathways, while also enabling us to study burnout and pathways that lead to undesirable outcomes for the faculty member.

ASU ADVANCE will focus on the mid-to-late career, as that is the time in which we see the greatest equity differentials in advancement and leadership at ASU. Furthermore, the mid-to-late career academic life course has been less of a focus for prior NSF ADVANCE projects (although we note with interest the recent efforts of Seattle University and the Universities of Maryland and Maine). Our goal, therefore, is to develop interventions that provide more information and guidance that are currently missing, to implement those in a way that is broadly accessible through both face-to-face and digital interventions, and to ensure success by increasing the level of centralized monitoring of equity processes. By creating digitally enhanced interventions targeting the later part of the academic life course, we innovate because: 1) our ASU-specific research indicates gender-based disadvantage is most apparent in this part of the academic life course; 2) our research project will explore how academic leadership—broadly defined—is gendered; and 3) our review of other NSF ADVANCE projects shows this phase of the academic life course has been subject to fewer interventions and attendant research and evaluation.
Initiative 1: Ensure that faculty and administrator procedures on recruiting, promotion, evaluation, and retention explicitly address how to improve equity and diversity in an interdisciplinary structure.

To accomplish Initiative 1, ASU ADVANCE will be housed in the Office of the Provost in collaboration with the Vice Provost for Inclusion and Community Engagement. This decision emerges through observations of other successful institutional transformations by underscoring the importance of administrative leadership and accountability, a focus on problem solving at the unit level, and actual policy development as crucial in effecting lasting institutional change (Mitchneck et al. 2016; Stewart et al. 2016). This administrative placement ensures that the mission to enhance faculty equity is shared across the entire institution. As we identified in the problem analysis, equitable outcomes are improved through local innovation combined with greater centralization and monitoring—concurrent, multilevel organizational strategy. This approach is consistent with our public-values based institutional change strategy, which sets high-level public values to accomplish, empowers local levels to solve identified problems, then establishes monitoring and accountability mechanisms to ensure the public values outcomes are met. We seek to realize a public value to ASU ADVANCE by ensuring equity and inclusion along multiple and intersecting dimensions are the responsibility of every employee of the university. The Institutional Transformation Team, led by PI Elizabeth Wentz will coordinate with the Administrative Accountability Team (headed by co-PI Lenore Dai) to spearhead these efforts across the institution. The most important changes will be for the provost to require that equity be assessed in dean, unit head, and faculty annual evaluations, in tenure and promotion decisions, and in evaluating research proposal teams.

We identified that women and other underrepresented faculty members are deterred and delayed at multiple points of the academic life course—pre-tenure, promotion to full, and assuming leadership positions—and that these differential processes occur in the absence of administrative monitoring and accountability. Initiative 1, therefore, establishes authentic, equitable faculty evaluation procedures throughout the academic life course. At the request of the provost, the College of Liberal Arts and Sciences (CLAS) undertook an equity and inclusion strategic planning process last year, which identified that nearly all units in CLAS have significant efforts aimed toward equity based on gender, race, and ethnicity at the earliest stages of the STEM pipeline (CLAS 2017). By contrast, few units had formal programs related to retention and advancement beyond assistant professor, with many units lacking any activities related to diversity and inclusion among faculty. This is particularly problematic given our identified problem with faculty retention at the earliest part of the academic life course and faculty advancement in the later stages of the academic life course. A recently published strategic plan for the Biodesign Institute—a research center with which many STEM faculty are affiliated—prioritizes gender equality and diversity among its top five strategic leadership priorities (Guston 2017).

Building on the 2017 strategic planning process, the vice provost for inclusion and community engagement asked academic colleges to develop strategies to address identified shortcomings, with a focus on the academic life course. This engagement of departmental units in problem solving is consistent with the public value-based organizational design model that has been implemented for other large-scale institutional change at ASU (e.g., reorganization from disciplinary to interdisciplinary units, and diversifying the undergraduate student population). Because this type of analysis applied to the academic life course is new at ASU, ASU ADVANCE will provide analytic and programmatic support to units in evaluating and identifying how specific processes and transitions work within units with respect to a range of unit-level decisions, including: administrative support; recruitment pools; faculty work load; family accommodations; grants teams; timing of grantspersonship, promotions; and leadership opportunities. As in every aspect of ASU, such analyses and programmatic interventions must also consider how units evaluate interdisciplinary work (Klein and Falk-Krzesinski 2017), especially in light of identified equity concerns and the need to identify institutional loci—not individuals—for intervention (Armstrong and Jovanovich 2015). Accountability for this part of the project stems from the provost, while technical assistance in accomplishing the changes comes from the ASU ADVANCE project team. The qualitative component of the social science research plan will ask faculty members about their
experiences with such departmental dynamics, and will enable exploration of intersectional differences in those experiences.

Recognizing that academic administrators are responsible for being aware of and advocating equity, the provost sponsored the 2017 attendance of three deans to ally training, including the Schools of Engineering dean and the College of Liberal Arts and Sciences dean—the focal units of our project. The provost’s office plans to sponsor attendance at ally training by all of its white male deans, as well as by the provost himself (White Men as Full Diversity Partners 2017). ASU ADVANCE will identify and promote opportunities for ally training and development at the administrative level. The Institutional Transformation and Administrative Accountability Teams will ensure annual administrator evaluations incorporate assessments of equity goals and outcomes. For example, we plan to follow the lead of other ADVANCE projects in requiring equity training for all faculty search committees, an initiative that will be backed up by the provost’s office through evaluation and monitoring (and which will, in turn, be evaluated by the Internal and External Evaluation teams).

ASU ADVANCE is concerned with equity across the academic life course. We will refer to established ADVANCE projects as examples of best practices, particularly for the early part of the academic career, which has been a major focus of prior ADVANCE projects (e.g., recruitment at University of Arizona and University of North Carolina at Charlotte, and mentoring at University of New Mexico and University of Montana). Our innovative focus will be to make certain that ASU’s practices evaluating and promoting faculty to full professors and identifying and fostering leaders are equitable and transparent across ASU STEM units.

Initiative 2: Provide appropriate and accessible professional development and mentoring opportunities for STEM women and members of underrepresented groups across the entirety of the academic life course.

Like many other ADVANCE projects, our assessment identified a need for greater attention to faculty development and mentoring. This is particularly important in ASU’s interdisciplinary schools when disciplinary mentors may believe that mentoring becomes someone else’s responsibility. Therefore we designed Initiative 2 to develop and deploy innovative professional development activities and mentoring opportunities for the later phases of the academic life course, including multiple leadership trajectories in an interdisciplinary context. Faculty members who choose to participate in these professional development activities will benefit from the resources of the ADVANCE project to develop and implement career advancement plans, which will lead to greater opportunities and advancement for diverse faculty. These activities will be deployed through a Digitally Enhanced Professoriate Plus (DEP+) platform, which builds on ASU’s recognized leadership in online educational development (U.S. News & World Report 2017b). For ASU, the DEP+ will provide faculty broad access to long-term, cost-effective professional development. We stress that we will not simply post PowerPoints or whitepapers on a website. Rather, we will create and deploy an online training platform to help faculty acquire and develop career-management skills as they navigate the complex academic life course in an interdisciplinary environment. The platform incorporates features of digitally enhanced education, including just-in-time training modules, short and medium-length interactive workshops and podcasts, mentoring circles, and the ability to assess use in real-time (Brooks 2010; New Media Consortium 2017; Paskevicius and Bortolin 2016). We will use Blackboard, which is already used for teaching all in-person and online courses, and for required staff training (such as anti-discrimination and cybersecurity). Online resources increase access for people living with disabilities. Blackboard’s capabilities further extend such access. In short, faculty and administrators are already familiar with the platform we will use, which will reduce transaction costs that would be involved with a new technology. Using Blackboard also will later help disseminate our work, as it is a widely adopted online system in higher education.

Professional development activities will be designed and developed by the Professional Development Team, headed by co-PI Erika Camacho. The team will be responsible for identifying interventions from other successful ADVANCE projects and creating new programs for middle-to-late academic life course professional development, training, and mentoring resources that incorporate
sensitivity to intersectionality dynamics, and address the challenges of our interdisciplinary environment.
The content expertise represented by this team will work with the Digital Platform Team headed by co-PI Philip Regier to deploy DEP+ professional development resources using state-of-the-art approaches to online education and curation. Two important models of such work are present in the NSF-funded Career WISE program for women graduate students, headed by team member Bianca Bernstein (CareerWISE 2017), and a series of online workshops building grant-writing skills developed by team member Faye Farmer (ASU Research Academy 2017). We emphasize again that workshops and training will also take place in-person; the digital enhancement for faculty will operate to increase access similarly to that for online students. In other words, digital availability will be just-in-time, will use a variety of modalities, and will enable faculty who are traveling, conducting field work, or geographically dispersed to engage in faculty development when it is convenient for them. Participation in these faculty workshops and training is voluntary. However, we will advertise and market the effort widely—particularly with support from the Institutional Transformation Team. For faculty who already understand the need for professional development, the ASU ADVANCE project will develop and provide resources not currently available at ASU. The DEP+ will help to reach faculty who may not ordinarily participate in equity training; such participation will help faculty members and administrators demonstrate commitment to equity in their evaluations (consistent with Initiative 1).

The second contribution for Initiative 2 will be an emphasis on mentoring. Mentoring is currently variably implemented at the unit levels and rarely at the later stages of the academic life course. Consistent with other successful ADVANCE approaches, ASU ADVANCE will create and promote opportunities to ensure all faculty have access to high-quality mentoring opportunities relevant for the academic career stage. Academic units will plan and implement face-to-face mentoring. Professional development will focus on both the mentee and the mentor, and will address professional planning across the academic life course. The DEP+ program will give faculty the opportunity to assess their career skills and to get training and mentoring through workshops and podcasts to help them achieve their goals in their careers and in the organization. CareerWISE (2017) provides an excellent model for this project activity. The ASU Faculty Women’s Association is already responding to the need for such programming with the planned development of several new workshops in 2018, including: Successful Promotion to Full, and Leadership Summit, which is designed to explore the varieties of academic leadership. An ADVANCE award will enable ASU to develop these workshops further into interactive just-in-time programming, as well as to identify new themes for training development. This approach is consistent with Britton’s (2017) findings that gender is not uniformly salient for academics (and, by extension, neither are other marginalized statuses) and that change strategies should fit with the way women experience gender in higher education, which is intermittent and context specific.

For this initiative, we plan to present in-person best practices in faculty equity and to innovate by developing and presenting new professional development modules, with a specific focus on the mid-to-late academic life course. Our project will further innovate by adapting in-person professional development to state-of-the-art online modules that are available just-in-time through an interactive web-based course management platform. The design and deployment of DEP+ (in addition to in-person programming) will enable short- and medium-term professional development groups to address specific advancement goals.

**DEP+ Just-in-time training modules across the life course**

Just-in-time training modules of varying lengths will cover content related to academic career management. Examples of just-in-time training modules include one, ten, and twenty-minute didactic presentations and podcasts related to career management processes, such as: tenure and promotion timelines, fostering reviewer networks, curating professional social media, and using mentoring committees throughout the career. The training materials will be available on-demand, which greatly enhances the accessibility of the training. Furthermore, the materials can be used in flipped classroom format, in preparation for participation in workshops, and mentoring on other areas of the platform. We
do not intend to replace in-person training and workshops, but rather to augment the reach of interventions by making them available in a digital environment.

**DEP+ Interactive workshops focused on transitions**

Short and medium-length face-to-face and online workshops will help faculty prepare for academic transitions and leadership. Short and medium-length workshops will bring groups of interested faculty together to prepare for major transitions, such as assembling promotion packages, using the sabbatical application to plan for promotion, competing for complex research grants, and preparing for new administrative or other leadership roles.

**DEP+ Mentoring Circles focused on skill development**

Interactive mentoring circles will be developed to support certain career management opportunities and challenges. As faculty members advance in their careers, they may opt to join interactive mentoring circles devoted to developing specific career management skills, such as managing interdisciplinary scientific research projects, curating social media presence, honing administrative expertise, or aiming for higher leadership positions. To enhance mentoring rapport between participants and further encourage participation, in-person social gatherings will be facilitated by the Professional Development Team.

**DEP+ Real-time data analytics for administrators**

The platform will have the ability to collect data in real-time, allowing immediate feedback to administrators, evaluators, and researchers. The platform will track actual online use patterns, which will enable real-time assessment and modification to improve effectiveness and efficiency. Furthermore, the platform will collect data to assess the interventions, to administer process and outcome evaluations, and to collect some data elements of the research plan.

**Initiative 3: Design, implement, and evaluate digital administrative systems to monitor equity-related processes, and empower administrators to intervene to ensure equitable opportunities and outcomes.**

Our ADVANCE program builds policy capacity at the administrative level (Initiative 1) and provides online mentoring resources and professional development capacity at the individual level (Initiative 2). Initiative 3 creates the administrative mechanisms to ensure accountability and results. This objective is consistent with the CLAS strategic plan, which calls for unit-level accountability for equity outcomes at every level and in every decision. Our needs assessment showed the greatest equity progress to date has been coupled with centralized administrative oversight. The digital systems give administrators timely information to monitor equity processes and to intervene when warranted.

An institution the size of ASU relies on many automated systems. Most noteworthy is the electronic student advising system, which has significantly increased retention of undergraduates, including those traditionally at risk. On the faculty front, administrative databases are used to identify faculty who are due to come up for tenure, and who are eligible for sabbatical leave. The provost’s office (through the deans) then notifies units and monitors the results. Similarly, the provost’s office requires diverse hiring pools and has stalled faculty searches that fail to meet diversity criteria. We propose to expand such systems to include other academic transitions such as to full professor. Although promotion to full professor is neither guaranteed nor on a time schedule, our research shows that the women who are successful with promotion to full professor are delayed in making this transition. A system that tracks cohorts of tenured faculty will enable the identification of delays, with follow-up by deans to guarantee all faculty equal opportunities to advance. Similarly, nominations to leadership from units tend not to be equitable; establishing and monitoring the pool of eligible senior faculty will allow the institution’s highest levels to identify potential talent independently of unit-level leadership. Finally, the project will monitor workload distributions for equity, with recommendations to the provost and deans for monitoring and follow-up.
Another example of one of our project innovations is to implement an equity-informed digital alert system in research administration. Given the centrality of external funding for research universities such as ASU, there is already a well-elaborated digital tracking system for grant proposals and management. We propose to amend the current proposal “sign-off” system (which already includes monitoring of various federal, state, and institutional requirements) so that it also requires an equity review with respect to roles and responsibilities, recognition, and overhead return. Proposals failing to demonstrate diversity at the project level, and equitable distribution of rewards and recognition, will be sent back to the principal investigator for change or further justification.

We will use the DEP+ platform and administrative resources of the ADVANCE project to identify and promote leadership opportunities at ASU. Leadership opportunity pathways will be identified through the first phase of the social science research project and will form the basis for professional development programming (Initiative 2). By fostering ASU-wide discussions about equity and inclusion throughout the academic life course and identifying specific opportunities and barriers to advancement, we hope to make the multiple pathways to leadership more apparent, and to provide support to enable individuals and the institution to ensure equity at every level as ASU moves forward. Finally, performance and outcomes will be acknowledged and publicized through the project website, and through annual diversity awards to administrators and faculty. We will use results from the CV analysis in the social science research project to identify and celebrate faculty and administrators following innovative leadership pathways.

In Table 3, we organize our initiatives in terms of objectives, interventions, outcomes, and data sources (for the evaluation). Quantitative indicators will be tracked according to NSF policy.

Project Evaluation

Internal Evaluation

The internal evaluation will be led by the College Research and Evaluation Services Team (CREST) at ASU. CREST includes three full-time evaluation professionals, all with advanced degrees and training in evaluation methodology. The evaluative framework relies on the Kellogg Foundation Systems-oriented Framework for Evaluating Social Change Efforts (2008). This framework allows for a multi-scale evaluation that includes a review of the relationships and patterns across the initiative. An initiative evaluation examines change over time and context. The ASU ADVANCE project spans capacity building from the administrative level to the individual level and addresses the administrative mechanisms to ensure accountability.

The formative evaluation design includes a review of progress toward the outcome objective. This portion of the evaluation design examines if the project is progressing satisfactorily according to its project plan. The CREST evaluation team will work with grant staff and faculty to monitor progress towards grant goals and conduct regular feedback sessions. In addition, exploratory, predictive, and self-organizing designs will be used to examine committee and unit-level processes as well as participant engagement, knowledge, and satisfaction levels.

The summative evaluation includes a longitudinal analysis of the collected data in order to understand what changes occurred and to what extent the changes are sustainable. The outcome/impact evaluation will measure, qualitatively and quantitatively, the impacts of the project in achieving its goals. At project end, CREST will provide a formal, summative report for the project PIs for internal review and for external reporting. Data sources are shown in the last column of Table 3.

External Evaluation

The external evaluation will be developed and implemented by Mariko Chang (Chang 2017). Formative evaluation will commence immediately and continue throughout the grant, providing quarterly feedback to refine activities and better measure the impact of program activities on goals, improve communication among stakeholders, and address challenges as they arise. At the end of the grant, a summative evaluation will assess how well the project has achieved its stated goals and realized the promise of intellectual merit and broader impact, including the impact of the project activities on gender
<table>
<thead>
<tr>
<th>Objective</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCE in Provost’s office</td>
<td>Establish administrative home</td>
<td>ADVANCE website; Stakeholders report project visibility, and institutional support for ADVANCE efforts</td>
<td>Project document review; Stakeholder interviews</td>
</tr>
<tr>
<td>Reduce bias in hiring practices</td>
<td>Face-to-face and digital workshops</td>
<td>Participants report: increased awareness of how to reduce biases in hiring; and using best practices in hiring. Increase hiring of women an underrepresented groups</td>
<td>Human resources data; Faculty pre-post survey; interviews; Institutional data</td>
</tr>
<tr>
<td>Consolidate information</td>
<td>Integrate diverse sources</td>
<td>Faculty report knowing where to obtain information for faculty policies, and improved transparency of policies</td>
<td>Document review; Website analytics, stakeholder feedback</td>
</tr>
<tr>
<td>Revise P&amp;T guidelines</td>
<td>Departmental technical assistance</td>
<td>Faculty report improved transparency of promotion and tenure process; Promotion timing gender gap closes</td>
<td>Project document review; Institutional data</td>
</tr>
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</table>

**Initiative 2: Professional Development and Mentoring throughout the Academic Life Course**

<table>
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<tr>
<th>Objective</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity training</td>
<td>Digitally Enhanced Professoriate Plus</td>
<td>Participants report: increased knowledge of diversity and inclusion; using information to improve diversity and inclusion; and improved climate</td>
<td>Faculty pre-post survey on content, climate, and interest; Website analytics; Interviews</td>
</tr>
<tr>
<td>Professional development plans</td>
<td>Digitally Enhanced Professoriate Plus</td>
<td>Participants report: improved opportunities for professional development, especially women and those at later phases of life course; receiving professional development to meet their needs and advance their careers</td>
<td>Faculty pre-post survey on content and access; Review of use and resources; Stakeholder interviews</td>
</tr>
<tr>
<td>Mentoring across the academic life course</td>
<td>Mentoring Committees</td>
<td>Participants report: knowing how to access mentoring resources; increased belonging, confidence, and engagement as a result of mentoring; mentoring resources to support career development</td>
<td>Faculty pre-post survey; Review of use and resources; Stakeholder interviews</td>
</tr>
<tr>
<td>Leadership training</td>
<td>Senior leadership coaching</td>
<td>Participants report: developing leadership skills; increased clarity of pathways to leadership. Increase women in leadership positions</td>
<td>Human resources and Institutional data; Faculty pre-post survey</td>
</tr>
<tr>
<td>Equity advocacy</td>
<td>Training Micro-credentials</td>
<td>Participants report: improved knowledge of intersectionality; taking actions to advance diversity and inclusion</td>
<td>Project document review; Interviews with administrators</td>
</tr>
</tbody>
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**Initiative 3: Digital Administrative Monitoring and Accountability**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor and intervene for equity</td>
<td>Digital Alert System</td>
<td>Administrators monitor and intervene for equity. Improved diversity in workloads, transition to full professor, and grant proposals</td>
<td>Human Resources data, Project document review.</td>
</tr>
<tr>
<td>Equity in every decision at every level</td>
<td>Annual Evaluation</td>
<td>Equity criteria established Accountability for equity</td>
<td>Document review Interviews with administrators</td>
</tr>
</tbody>
</table>
equity in STEM academics at ASU. Dr. Chang will provide written annual external evaluation reports. The external evaluation will incorporate both quantitative and qualitative data collected by the external evaluator, internal evaluator, and project team, including: interviews and/or focus groups with key stakeholders (leadership team, administrators, faculty, program participants, campus partners), participant surveys, workshop/event evaluation forms, and review of program documentation. The evaluation will be guided by the following questions:

- Is the project being implemented effectively and according to schedule?
- Are data being collected to provide baseline measures of desired outcomes and track progress toward project goals?
- How well has the project reached its goals? Are successful activities and policies being institutionalized?
- How effectively have results been disseminated to a broader national audience?

**Evaluation Objectives, Outputs, Outcomes, and Data Sources**

The elements of a program logic model are illustrated in Table 3, which provides sample outcomes and sources of data. All data will be collected annually other than data on activities, which will be collected at the time of the activity. Upon receipt of grant funding, the internal and external evaluators will work with the Social Science Research team to create a detailed evaluation timeline and logic model to guide evaluation activities and to establish baseline measures and indicators to measure progress toward program goals, including the impact of the activities on institutional change that supports gender equity in STEM at ASU. We note that required quantitative indicators will be tracked according to NSF policy.

**Institutional Commitment and Sustainability**

The project management structure includes key leaders at the university while incorporating stakeholders from throughout the university. The Institutional Transformation Team (ITT), which includes the university president and provost, is poised to effect real change across the campus. When ASU’s President sets a high-level objective, he reinforces it in his public speeches, writing, and action. Letters of commitment are provided for those named in the program management section as further evidence of institutional commitment and program sustainability.

Our proposal extends existing infrastructure and programs to ensure long-term sustainability. The review and revision of promotion and tenure guidelines in light of interdisciplinarity and intersectionality will be a labor-intensive process that will lead to new policies and procedures. The Digitally Enhanced Professoriate Plus applies ASU’s award-winning (U.S. News & World Report 2017b) online education experts to digital faculty development opportunities. The Digital Platform Team will work with the Professional Development Team to build on and extend the many successful workshops already developed by the Faculty Women’s Association and other ADVANCE projects. The administrative monitoring components will adapt existing systems to monitor a broader array of outcomes. For example, the system that currently tracks timing of tenure and sabbatical applications will be expanded to include timing of later promotions and assumption of leadership. The system that currently ensures compliance with a variety of grant-related regulations will be expanded to include equity assessment at the earliest phases of proposal development.

**Project Management**

The project will be implemented, managed, and advised through the ASU ADVANCE office in the Office of the Provost using multiple teams and advisory groups. The team members and interaction between the teams are shown in the management schematic supplied as a supplementary document. The project timeline is shown in Figure 1. The leaders and functions of each team are described below:

*Institutional Transformation Team* (PI Wentz lead). As the Social Sciences Dean in the College of Liberal Arts and Sciences (CLAS), PI Wentz will lead the Institutional Transformation Team. This team will be
responsible for developing and maintaining the messaging that translates into a cultural shift in attitudes, behaviors, and policies that reflects the public-value of equity in the careers of all STEM faculty at ASU. This team will work in direct partnership with the Administrative Accountability Team, which will be responsible for the specifics of the transformations integral to Initiatives 1, 2, and 3.

Administrative Accountability Team. As an ASU leader and Director of one of the Fulton Schools of Engineering, co-PI Dai will lead the Administrative Accountability Team. This team will be responsible for structuring the top-down accountability for ensuring that faculty and administrator recruiting, evaluation, and retention procedures are equitable and oversee the implementation of academic unit-driven policies and procedures especially those in Initiative 1 and 3.

Professional Development Team. As a nationally recognized leader in mentoring with a particular focus on women and members of underrepresented groups, co-PI Camacho will lead the Professional Development Team. This team will design and deploy the implementation of face-to-face and digital materials including workshop materials, leadership training, and mentoring critical to Initiative 2.

Digital Platform Team. As the University Dean for Educational Initiatives and CEO of EdPlus at ASU, co-PI Regier will lead the Digital Platform Team. His knowledge and expertise will bring novel, high quality, and accessible materials to the Digitally Enhanced Professoriate Plus component of ASU ADVANCE, particularly those activities in Initiative 2.

Social Science Research Team. As a scholar in the field of sociology of academic careers, co-PI Gaughan will lead the Social Science Research Team, which includes Barry Bozeman and Mary Romero. Our research approach utilizes an academic life course theoretical framework and focuses on the impact of interdisciplinarity and intersectionality on career trajectories. Research findings will inform us on how to adapt interventions in Initiatives 1, 2, and 3, as well as contribute to the academic and policy literature.

Internal and external advisory activities will be coordinated through the Institutional Transformation Team (PI Wentz lead), while internal and external evaluation teams will be coordinated by co-PI Gaughan (Social Science Research Team).

Social Science Research Project

The social science research project utilizes a life course theoretical framework to consider how individual agency, lifelong development, interdependence of human lives, and historical time and place affect the timing, pace, and pattern of academic lives (Elder 1994). The emergence of a new academic context—the explicitly interdisciplinary research university exemplified by ASU—provides a new opportunity to understand how the development of the academic life course is affected by interdisciplinarity. Furthermore, intersectional theory demands that we consider that the organization of human lives and opportunities vary according to known and intersecting bases of stratification. We propose a mixed-methods social science research plan that will enable us to answer the overarching research question on how a consideration of intersectionality in an interdisciplinary environment affects our knowledge about patterns and outcomes in the academic life course. More detail is provided in the separate five-page social science research plan.

Communication and Dissemination Strategy

ASU ADVANCE seeks to communicate activities and results broadly. Consistent with NSF expectations, we will create and maintain a dedicated website to promote the project and provide access to digital materials, rubrics, and other materials both inside and outside of ASU. The project manager will work with ASU social media experts to establish and maintain social media for marketing and communications. Consultation with ASU social media experts will ensure that our project is employing the best practices to brand ASU ADVANCE, generate consistent traffic, celebrate project successes, and use social media to inform and inspire people about our project. We will publish in peer-reviewed journals (e.g., Nature, Science, NSF ADVANCE, The Journal of Higher Education, Research Policy) and higher education periodicals (e.g., Chronicle of Higher Education, Inside Higher Ed). We will participate
in national conferences to promote the activities and impact of the ASU ADVANCE program (e.g., NSF, Science of Team Science, and national professional associations) through presentations and posters.

**Broader Impacts**

Our innovative dissemination strategy is to create a regional learning circle focused on faculty equity at Hispanic Serving Institutions, and those—like ASU—on track to be so designated. We will invite our local community colleges, with which ASU has numerous formal linkages, including through the Schools of Engineering in the NSF INCLUDES project. We will also invite our two other state universities—the University of Arizona, which is a past recipient of an ADVANCE award, and Northern Arizona University, which is located next to the Navajo nation. We will invite near neighbors who are current or past ADVANCE awardees, including the University of New Mexico, New Mexico State University, and two Universities of California, Davis and Irvine. The objective of the regional learning circle will be to share best practices in recruiting and retaining diverse faculty members with a special focus on Latina and Native American women.

**Figure 1. Timeline with Activities and Milestones (including evaluation)**

<table>
<thead>
<tr>
<th>Initiation 1: Equitable Interdisciplinary Policies</th>
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<tbody>
<tr>
<td>ASU ADVANCE Placement in Provost’s Office</td>
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<tr>
<td>Diverse Hiring in STEM</td>
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<tr>
<td>Revision of Promotion and Tenure Policies</td>
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<tr>
<th>Initiation 2: Professional Development and Mentoring Throughout the Academic Life Course</th>
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<tbody>
<tr>
<td>Mentoring</td>
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<tr>
<td>In-Person Workshops</td>
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<tr>
<td>Digitally Enhanced Professorate</td>
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<tr>
<td>Leadership Development</td>
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| Initiation 3: Digital Administrative Monitoring and Accountability                      |
| Workload Monitoring System                                                            |
| Grant Proposal Monitoring System                                                     |
| Promotion Monitoring System                                                           |

**Social Science Research**

| Institutional Data Collection                                                  |
| Curriculum Vitae Data Collection                                               |
| Semistructured Interviews                                                      |
| Analyses and Publication                                                        |

**Program Evaluation**

| Internal                          |
| External                         |
| NSF Site Visit                   |

**Communication and Dissemination**

| Project Website                  |
| Social Media Outreach            |
| Regional HSI Conference          |

**Legend**

- Annual updates or reports
- Summative report
- Event
- Quarterly feedback
- Ongoing activity
- Developmental activity
Results from Prior NSF Support

E. Camacho, Co-PI (a) DMS-1263374, $540K, 2013–2018; (b) REU Site: Mathematical and Theoretical Biology Institute (MBTI); (c) Intellectual Merit: MTBI is an 8-week REU that recruits URM. Students became well-versed in mathematical biology, dynamical systems, and many computer software packages. Students work on real-world applications, produce technical reports, and present their work at the Joint Math Meetings and SACNAS. Broader Impacts: Diverse: Issues in Higher Education recognized MTBI as the largest producer of Hispanic PhDs in the mathematical sciences, MTBI produced 75 PhD alumni with 59 URMs since 2005 (out of 216 people). (d) 24 publications and technical reports were produced; (e) see references; (f) N/A

L. Dai, Co-PI (a) NSF 1744539, $300K; 9/15/2017-8/31/2019; (b) NSF INCLUDES DDLP: Fostering Engineering Identity and Support Structures to Promote Entry and Persistence in Engineering for First-Generation Students; (c) Intellectual Merit: Aims to develop innovative ways to make engineering personally and socially relevant; addresses entry and persistence in engineering of first-generation students, those with socioeconomic need, women, and underrepresented minorities. Broader Impacts: Promotes the transition and success of first-generation students in engineering and diversifies future workforce. Developed model is anticipated to be useful and make an impact regionally and nationally; (d) No publications were produced under this award; (e) N/A; (f) N/A.

Gaughan, M., co-Principal Investigator (a) NSF #1537879, 8/21/2015-8/31/2018; $249,811. (b) Collaboration Cosmopolitanism and Scientific and Technical Human Capital: Implications for Women and Underrepresented Minorities (c) Intellectual Merit: Contributes to domestic studies of the diversification of the scientific workforce by focusing on bachelor’s level scientific workers, an understudied group. Assesses the role collaboration cosmopolitanism plays in the work outcomes of scientific workers. The project improves our understanding of the factors that increase job satisfaction and productivity among STEM workers. Broader Impacts: Locally, the project has contributed significantly to the training of two minority female doctoral students. In addition, results from this project have been presented at international meetings, exposing scholars in the fields of public management and science policy to problems associated with the diversification of the scientific workforce. (d) Publications: Jung, Jiwon, Barry Bozeman and Monica Gaughan. 2017. Impact of Cosmopolitan Research Collaboration on Job Satisfaction. Research Policy. https://doi.org/10.1016/j.respol.2017.09.003; two additional manuscripts are currently under peer review. (e) Research Products: Project uses contract data set maintained by the National Science Foundation. (f) N/A.

P. Regier, Co-PI does not have any NSF-funded projects that started in the last five years.

Wentz, E., co-Principal Investigator (a) GEO #1600562; 09/01/16-08/31/19; $481,235. (b) GP-IMPACT: Collaborative Workforce Training in Geoscience and Social Science for Natural-Hazards Preparedness and Mitigation (HazPM). (c) Intellectual Merit: Designs and implement an undergraduate workforce-training program. Natural scientists, engineers, and social scientists are necessary to prepare for and mitigate natural hazards because hazards originate and occur in the interfaces between natural systems and societies. Broader Impacts: Design plan results in an innovative, fully accessible, and rigorously tested undergraduate curriculum implemented regionally and disseminated nationally. Through collaboration with faculty at regional two-year colleges that serve major populations of Native American and Hispanic/Chicano/Latino students, the HazPM project team will also increase access and professional opportunities in the sciences for underrepresented minority students. (d) Publications: The project is in its data-collection phase and therefore no new results exist yet. (e) N/A; (f) N/A.
References


http://dx.doi.org/10.1016/j.respol.2017.03.001


The social science research project utilizes a life course theoretical framework (Elder 1994), to examine the academic life course, with attention to how agency, lifelong development, interdependence, and historical time and place affect its structure (Bozeman et al. 2001; Hermanowicz 1998, 2010; O’Meara 2015; O’Meara et al. 2008; Zippel 2017). The emergence of a new academic context—the explicitly interdisciplinary research university exemplified by ASU—provides a new opportunity to understand how the development of the academic life course is affected by interdisciplinarity (Leahey et al. 2017; Rhoten and Pfirman 2007). Furthermore, intersectional theory demands that we consider that the organization of human lives and opportunities vary according to known and intersecting bases of identification and stratification (Acker 2006; Browne and Misra 2003; Collins 1990; Romero 2018). In this social science research plan, we propose a mixed-methods social science research study to investigate how intersectionality and interdisciplinarity affect the organization of the academic life course. Specifically, we are interested in how STEM faculty develop their academic careers in an explicitly interdisciplinary university, and how their career experiences differ based on intersectional dynamics as they emerge in the academic life course. Consistent with our ADVANCE project as a whole, we are interested in the academic life course from beginning to late career, and will ensure that both quantitative and qualitative components include faculty members at each stage of the academic life course.

**Theoretical Orientation of the Research Plan and Research Questions**

To summarize an abundant literature on scientific trajectories in the United States: Academic faculty in STEM fields are disproportionately male, White, Asian, and able-bodied (NSF 2017); they tend to achieve academic milestones more quickly than others and face fewer barriers on the path (Long and Fox, 1995; Xie and Shauman 1998). Women, members of domestic racial and ethnic groups, and people living with disabilities, are significantly underrepresented among academic STEM faculty (NSF 2017). To complicate matters still further, individuals can have multiple identities and statuses: The empirical examination of intersectionality is still young, but the theoretical framework properly problematizes the idea that one can occupy only one disadvantaged status at a time (Acker 2006; Browne and Misra 2003; Collins 1990; Romero 2018). A major contribution of our research project is that it will use a mixed methods design to enable us to evaluate multiple and intersecting bases of theoretically relevant differences in the organization of the academic life course.

Interdisciplinary scientific research is a critical component of the nation’s scientific investments, yet relatively little is known about how it functions, particularly with respect to intersectional equity concerns documented in other aspects of the academic enterprise (e.g., career trajectories, intellectual property, and publication productivity). Furthermore, a hierarchy of disciplinary prestige means that in the academic research university, disciplinary perspectives constitute context-specific bases for social stratification—even within an explicitly interdisciplinary university. Finally, the development of the later academic career—including the multiple leadership trajectories that are possible—is understudied in general and especially with respect to intersectional equity and interdisciplinary concerns. The research project will make original theoretical, methodological, and empirical contributions to the international literature on higher education, interdisciplinary science policy, research management, science indicators, and science studies, as well as the burgeoning literatures on intersectionality in the context of the academic life course and interdisciplinarity in the context of academic science.

Our research approach takes an explicitly intersectional life course theoretical orientation that considers how individual agency, lifelong development, interdependence of human lives, and historical
time and place affect the timing, pace, and pattern of human lives (Elder 1994). The life course framework was originally developed without attention to the ways in which gender, race, ethnicity, class, national origin, and sexual orientation may affect how professional and personal life courses unfold. Several scholars of academic scientists have taken the life course theoretical perspective in their work, with varying degrees of attention to the challenges of an intersectional perspective (Armstrong and Jovanovic 2015; Bozeman et al. 2001; Bozeman and Gaughan 2007, 2011; Gaughan et al. 2017; Hermanowicz 1998, 2010; Zippel 2017), or the ways in which interdisciplinarity affects the organization of scholarly lives (Leahey et al. 2017; Rhoten and Pfirman 2007).

Life course theory takes an inherently contextual, social approach to understanding human lives. Intersectional theory demands we consider that the organization of human lives and opportunities vary according to known and intersecting bases of stratification. Finally, the emergence of a new academic context—the explicitly interdisciplinary research university exemplified by ASU—provides a new opportunity to understand how the development of the academic life course is affected by interdisciplinarity. Our overarching research question is:

*How does a consideration of intersectionality in an interdisciplinary environment affect our knowledge about patterns and outcomes in the academic life course?*

This general overarching question gives rise to several specific research questions our research plan is designed to address:

**Research Question 1:** What are the varieties of leadership pathways in an interdisciplinary academic environment?

**Research Question 2:** What are the perceived opportunities for and barriers to career management and advancement in an interdisciplinary environment?

**Research Question 3:** How does the academic life course in the explicitly interdisciplinary environment of ASU differ from academic career trajectories in other research universities?

Cutting across all three of these research questions is:

*How do gender, race, ethnicity, foreign-born status, sexual orientation, and disability—and their intersectionality: 1) explain differences in the pattern and velocity of the life course; and 2) structure the varieties of actual and perceived leadership opportunities?*

To summarize, we take an intersectional life course approach to theorize about and empirically evaluate determinants of academic career paths and outcomes in an interdisciplinary environment.

**Social Science Methodology**

Life course analysis and intersectional analysis share common conceptual concerns with the role of human agency, timing, the interdependence of social lives, and the importance of social context. Intersectionality is a concept developed in law to highlight the legal complexity of occupying multiple marginalized statuses (Crenshaw 1991). African American feminist theorists further developed intersectionality to show how lived experience is comprised of multiple interacting factors that combine in complex ways and depend on specific social contexts for salience (Browne and Misra 2003; Cho et al. 2013; Collins 1990; Collins and Bilge 2016; Davis 2008; Dill and Zambrana 2009; Romero 2018). Intersectional analysis focuses on the interaction among statuses, not just on direct effects (Bowleg 2008; Choo and Marx Ferree 2010; Weldon 2008). From a quantitative perspective, this implies the need for large samples, which are difficult to accomplish in higher education given the well-documented distributional inequities (Leggon 2006). A recent paper by co-PI Gaughan used intercategorical analysis...
of multiple groups strategically (McCall 2005) to test hypotheses about how professional social network resources and intersectionality influence scientific productivity (Gaughan et al. 2017).

Population and Sampling

Our study population uses a census of STEM faculty members from the College of Liberal Arts and Sciences (CLAS) and the Ira A. Fulton Schools of Engineering, which together represent 42% of ASU faculty and the majority of STEM faculty members at ASU. The census is possible because institutional data and academic curricula vitae are available for every faculty member. Institutional data will be the primary way we evaluate representativeness of participants in the qualitative arm of the study. For the qualitative arm of the study, we will employ purposive sampling to ensure that a variety of faculty (e.g., by gender, race and ethnicity, rank, disability status, and sexual orientation) are represented in the semi-structured interviews. Some of these target participants will be identified by institutional data (e.g., rank, gender, race and ethnicity), while other target participants (e.g., faculty with disabilities and LGBT faculty) will be identified through snowball sampling. This modification of the successful Netwise II (Gaughan et al. 2017) sampling plan will result in a qualitative sample size of 120, which will ensure theoretical saturation along the bases of gender, race, ethnicity, sexual orientation, foreign-born status, and disability.

Data Sources

Curriculum Vitae Analysis for the Study of Academic Trajectories

To study interdependence, timing, and institutional change, we will use the academic CV in tandem with institutional data (for timing of academic reorganizations and family leave) to understand how timing of macrostructural changes interact with personal and professional life course timing; the timing of life course transitions often differ by statuses of intersectional theoretical interest. We use the curriculum vitae as a de facto prospective source of longitudinal academic career data; to date, the CV has been used to study the academic life course, with a particular focus on gender (Gaughan 2009, 2017b; Gaughan and Ponomoriov 2008; Gaughan and Robin 2004). Recent work uses survey data combined with the CV to explore the later career path, including the intersectional bases of gender, racial, and ethnic stratification in promotion to the full professor position (Gaughan 2017b), and how these bases of stratification affect scholarly productivity throughout the academic life course (Gaughan et al. 2017).

At Arizona State University, every faculty member posts a current curriculum vitae on the institution’s publicly accessible website. These updated CVs will form the baseline for the CV component of the analysis, with later multi-method data collection techniques focusing on updating the life course data. Concepts to be captured from the CVs include educational history, prior employment, timing of transitions, order of trajectories, and leadership pathways; specific methodological details are well described in Canibano and Bozeman (2009), Dietz and colleagues (2000), and Gaughan (2009).

Gaughan’s current work uses sequence analysis (Abbott and Tsay 2000) of academic positions throughout the academic life course using the CVs of 2400 academic scientists in four scientific fields. The sequence analytic work constitutes a critical comparative basis for our planned analysis of ASU CVs, which will enable us to compare academic career trajectories in the explicitly interdisciplinary environment of ASU to those observed at other research universities, and to assess the extent to which the academic life course—with a focus on the post-tenure career—varies by gender, race, ethnicity, foreign-born and disability status.

Semi-structured Interviewing to Study Intersectionality, Barriers and Opportunities

Intersectionality theory recognizes that multiple identities operate for individual people and that the salience of these identities, and of the ways in which they intersect, vary not only between individuals, but in different social contexts. These ideas have been well articulated theoretically and qualitative research demonstrates that person, context, and timing all play important roles in how intersectional identities and attributions are activated (Acker, 2006; Browne and Misra, 2003; Crenshaw, 1989; Collins, 1990). It is extremely difficult to conduct quantitative intersectional analysis in samples of academics
because of the “small n” ethical problem that necessitates suppressing subgroup analysis in the interest of protecting subjects (Leggon 2006). The Netwise II project achieved large enough subsamples to explore intersectional hypotheses quantitatively (Gaughan 2017b; Gaughan et al. 2017); however, even assuming recruitment of every faculty member of color and LGBT at ASU into the research study, we will not have sufficient cell sizes for quantitative analysis of all intersectional bases.

Given the difficulties of using quantitative analysis for intersectional analysis, we propose to explore intersectional dynamics using qualitative semi-structured interviewing to understand how professors construct their life course in the ASU interdisciplinary environment. The project interventions are designed to help STEM faculty with this process, while the evaluation plan is designed to document what impacts the interventions have. The semi-structured interviews provide an opportunity for exploring in-depth how faculty perceive and experience opportunities and barriers to advancement in the rapidly changing interdisciplinary environment, and to explore how intersectionality affects career decision making and planning among faculty. An important structuring device for interviews will be the participant’s curriculum vitae (which will have been collected in the earliest phase of the research). The CV constitutes a professional record of professors’ work, but it is socially constructed by norms that may not reflect the actual work the professor does in his or her “workload” (Initiative 1 of the ADVANCE intervention project will be an important source of institutional information about these social processes in faculty evaluation and workload allocations). The CV will help the interviewers to ask about what is present and what is not present in the CV. For example, we know from other work (Gaughan and Bozeman 2016) that publications alone are not a sufficient indicator of collaborative scientific work. Because collaboration is often an integral component of interdisciplinary work, understanding its dynamics requires moving beyond the official record. Furthermore, the CV provides at best minor clues about gender and other intersectional dynamics: Scientific work presented on a CV is work that has occurred in a gendered and racialized environment, which will be interrogated in the semi-structured interview format.

The interviews are the means for exploring how identities operate and interact to affect perceptions, aspirations, and advancement in the interdisciplinary environment. The semi-structured interview protocol will be developed using: 1) field notes from our ongoing discussions among stakeholders in developing this proposal; 2) the results of the CV trajectory analysis described above; and 3) reference to other qualitative work on the academic life course (Fox and Colatrella 2006; Hermanowicz 1998, 2010; Gaughan and Bozeman 2016; Gardner and Blackstone 2013; O’Meara 2015), including other NSF ADVANCE projects that have employed semi-structured interviews (e.g., Seattle University, University of Maryland at College Park, University of Delaware).

**Relationship of Research Plan to Evaluation**

As described in the main body of the proposal, the programmatic innovation is to develop an integrated digital platform for the delivery of both didactic and interactive training and mentoring, as well as digitally-enhanced administrative monitoring and accountability. This platform will be used to collect data related to both the evaluative and research components of the project. In the main body of the proposal, we discussed how the platform will be used for evaluation and monitoring of the project in more detail. The planned research interviews will provide an opportunity to ask whether and to what extent faculty members perceive ASU ADVANCE as a resource for their own career development (faculty will be recruited for interviews whether or not they participate in training interventions). Finally, co-PI Gaughan will serve as the primary project liaison with both the Internal and External Evaluation Teams. An early activity of the project will be for these three teams—Social Science Research Team, and Internal and External Evaluation Teams—to plan and coordinate data collection and curation activities.

**Measures**

Our work takes into account the dynamic nature of the academic life course in changing institutional contexts. We will explore constructs from several theoretical domains of social science research: Life course, intersectionality, and interdisciplinarity. Furthermore, we will measure these...
constructs using both qualitative and quantitative methods and sources of data. The table on the next page shows in the left column the major construct categories. The middle column indicates variables to represent those constructs; the right column identifies the data sources that will be used to derive specific measures of the constructs.

 Constructs, Variables, and Data Sources for the Social Science Research Plan

<table>
<thead>
<tr>
<th>Construct</th>
<th>Variables</th>
<th>Data Source</th>
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<tbody>
<tr>
<td>Life Course</td>
<td>Positions, Promotions, Leadership</td>
<td>Curriculum Vitae (CV)</td>
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<tr>
<td></td>
<td>Leave Taking and Accommodations</td>
<td>Institutional Data</td>
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<td></td>
<td>Mentoring and Advice Networks</td>
<td>Semi-structured Interviews</td>
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<td></td>
<td>Timing of Institutional Changes</td>
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<td></td>
<td>Identity Groups</td>
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<td></td>
<td>University Units</td>
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<tr>
<td>Interdisciplinarity</td>
<td>Interdisciplinary Affiliations</td>
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<tr>
<td></td>
<td>Interdisciplinary Collaborations</td>
<td>Semi-structured Interviews</td>
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Analysis
We will conduct comparative sequence analysis and event history analysis of CV data to answer research questions related to how interdisciplinary trajectories differ from more traditional disciplinary trajectories and—to the extent possible given sample sizes—to evaluate how intersectionality and interdisciplinarity interact to explain differences in such trajectories. The comparison group for the sequence analysis relies on 2400 CVs collected by members of the research team over the last ten years.

When permitted by participants, interviews will be recorded and transcribed; otherwise, interviews will take place in pairs of investigators, with one person playing lead interviewer and the other playing the role of note-taker. We will then use thematic analysis of the semi-structured interview transcripts (or notes) to answer the research questions related to how faculty members negotiate intersectionality and interdisciplinarity in their career planning and advancement.

Research Team
The lead investigator for the social science component of the project is co-PI Monica Gaughan, who applies life course models to the study of scientific careers. Her expertise is in sampling and statistics, with an emphasis on over-sampling scientists to attain adequate cell sizes for intersectional analyses by gender, race and ethnicity. She also has extensive experience interviewing scientists and engineers. ASU Professor Mary Romero is the president-elect of the American Sociological Association. She specializes in intersectional approaches to understanding occupations and the workforce, with a focus on Latinas and other women of color. Her methodological expertise is in participant observation and semi-structured interviewing, with attendant expertise in grounded and thematic content analysis. She is the author of a new book, *Introducing Intersectionality* (2018), published by Polity Press. ASU Regents’ Professor Barry Bozeman is the creator of the public values theoretical perspective that informs our project’s theory of organizational change (Bozeman 2007); in addition, he is a leading scholar of science policy, with a focus on the interface between interdisciplinary careers and institutional environments. He is an innovator in using the academic CV to study scientific careers, and has interviewed more than 1000 scientists over the course of his career. Details about the qualifications and experience of the social science research team are available among the biosketches.