

An External Mentor Program: A Pathway to Career Advancement for Women in STEM

Issues of scholarship development and career advancement are central to effective functioning of universities and other academic settings, especially during times of decreased federal and state funding, variable student enrollment, and faculty mobility (Haines & Popovich, 2014). Faculty development represents a broad spectrum of activities, and in research-oriented settings typically prioritizes scholarship and advancement in terms of research productivity. These faculty development efforts can be expected to play a particularly salient role in career advancement for women faculty in Science, Technology, Engineering, and Math (STEM) fields, given traditional barriers to participation in leadership and promotion in rank (Chen, 2013; Chen & Soldner, 2013; National Science Foundation, 2013; O'Meara, 2015). Mentorship programs represent a low-cost mechanism for faculty development, which can play a transformative role in faculty career advancement, especially for women in STEM (Ben-Shachar, 2014). Research addressing effects of mentoring has demonstrated numerous positive contributions to career outcomes for women in different organizational contexts, including academia. These positive outcomes were observed at the individual and systemic levels and include: increased productivity, enhanced communication, organizational stability, retention of employees, and support of cultural diversity (for extensive selected readings, see: Allen & Eby, 2011; Allen et. al, 2004 & 2017; Eby & Lockwood, 2005; Ragins & Kram, 2007; Ragins & Cotton, 1999; Ragins & Scandura, 1999; Scandura, 1992). Importantly, for women scientists, mentorship was found to enhance their interest in STEM (Heilbrunner, 2012), foster caring communities (Chesler & Chesler, 2002), promote a sense of collegiality (Gorman et al., 2010) and feminist views of organizational structures/dynamics (Morimoto & Zajicek, 2012).

Individual positive mentoring outcomes (e.g., increased productivity and interest in STEM) may be in part a function of overcoming the “confidence gap”, ascribed to multiple causes and noted for women scientists in STEM fields (Ben-Shachar, 2014). A successful mentoring relationship benefits the mentee, his/her organization, and in some ways the mentors. Moreover, faculty involved in mentoring relationships reported feeling more confident than their counterparts not actively engaged with mentors and demonstrated enhanced research productivity and career satisfaction (Skeff, Stratos, & Mygdal, 1997; Zinn, 1997).

The American Association of Colleges of Pharmacy (AACP) Joint Council Task Force on Mentoring has defined mentoring as a relationship with someone who is usually a more advanced colleague. Moreover, in an academic setting, a mentor is charged with helping the protégé in setting and prioritizing short and long-term career goals. At the same time, the mentor functions in a manner similar to a cheerleader, “championing the fulfillment of goals, and believing firmly in the abilities and worth of the protégé” (Law et al., 2014, p. 2). Importantly, mentors help the protégé with networking, introducing him/her to senior scientists in their area of expertise (Cho, Ramanan, & Feldman, 2011; Haines, 2003; Schrubbe, 2004). Best practices recommendations based on the AACP Joint Council Task Force on Mentoring emphasized a need for a formal relationship, for example, with dedicated time for mentor and protégé to meet regularly, along with more serendipitous interactions. A systematic assessment process to gauge effectiveness of the relationship was also described as important (Law et al., 2014).

Although mentoring is typically provided by more senior in-house faculty, there is considerable advantage to having external experts serve as mentors, especially to more advanced mentees. External mentors can provide critical information, such as expectations for productivity in other research-intensive settings, and effective work patterns (Haines & Popovich, 2014).

External mentors can be more objective and unbiased and not affected by organizational relationships. Moreover, these outside experts offer fresh networking opportunities beyond the walls of the mentee's institution.

Benefits of participation in mentoring relationships have been empirically examined, although typically with small numbers of participants. Mundt (2001) evaluated an external mentor program for nurses, designed to assist participating faculty in research program development. The program was carried out over 2.5 years, with 9 faculty members involved. Faculty made connections with the prospective mentors, describing their research and the goals of the program, and inquiring about the mentor's interest in participation. Program participation resulted in increased applications for extramural funding to a variety of federal, national, state and local agencies by mentees. According to Mundt, some of the biggest gains came from the fact that mentees were: "impressed with the accomplishments of their mentors and respected their commitment to scholarship and consistent hard work" (p. 44). Participating mentees were also described as more focused in their effort, gaining an appreciation for the cycles of scholarly work, and the pipeline of pilot work, grant proposals, presentations, and publications. Another recent implementation was described by Haines and Popovich (2014), wherein 13 School of Pharmacy faculty members were introduced to their mentors by the Dean, after having been matched on the basis of interests. Similar to the program evaluated by Mundt (2001), faculty members viewed the relationship with the mentor as a unique opportunity, which in turn motivated them to meet the goals of the program agreed upon with their mentors. Participating faculty reported feeling supported by their mentors, and in turn more resilient to the pressures of internal competition. Importantly, mentees expressed that they felt their mentors had a sincere interest in seeing "them flourish in their faculty role" (Mundt, 2001, p. 5).

In this study, we set out to examine a number of quantitative and qualitative outcomes for participants in the Washington State University (WSU) External Mentor Program, supported by an ADVANCE Institutional Transformation (IT) grant from the National Science Foundation (NSF). We hypothesized that participation in this program would result in: (1) high ratings of satisfaction, achievement, and professional gains; and (2) high levels of research productivity, indexed by numbers of submitted and funded grant applications, as well as total dollars of these awards. In addition, an exploratory component of the present study involved in-depth semi-structured interviews with a subset of faculty members (n=10) participating in the External Mentor Program. Thus, the present study extends the existing literature by including a larger, more representative sample of women faculty in STEM fields, including qualitative as well as quantitative data. Women faculty across multiple STEM fields participated over the course of 5 years, reporting satisfaction with the program as well as scholarship gains and career advancement more generally.

Method

External Mentor at WSU

External Mentor participants were recruited through a dissemination effort targeting STEM disciplines using a two-fold strategy. First, department chairs communicated with eligible faculty members in their units, encouraging these women to take advantage of the program. Second, ADVANCE at WSU liaisons appointed from all STEM-related units approached female tenure-track faculty eligible for the program, also disseminating information regarding the External Mentor opportunity. In addition, the 5th author (RC) contacted all eligible WSU women faculty in STEM fields directly (N=80) to encourage them to apply and to provide assistance

with application development. When faculty expressed interest, email contact was typically followed by telephone or in-person exchanges to assist faculty in developing a proposal.

ADVANCE at WSU supported the mentoring relationship, yet each participating faculty member was responsible for identifying her mentor and making arrangements with them.

ADVANCE at WSU provided guidance to faculty regarding identifying an appropriate mentor and related topics (e.g., building and sustaining collaborations, networking, etc.) as needed, and established contact with the mentor, once the mentee had initiated the relationship. The faculty member seeking a mentor was seen as best positioned to determine the type of mentor who could advance her academic career/scholarship most effectively. Faculty were told this advancement was broadly construed, and could involve the same, or a closely related field of study, and include a range of activities, such as training in different methods/experimental techniques, depending on the goals of the individual mentee. Strategies proven successful in identifying potential mentors, describing the program, and obtaining commitment, were discussed with mentee faculty, as needed.

An external mentor was expected to be a senior faculty member from another university and/or a respected, well-established scientist in the mentee's research area, or related field. The mentor needed to agree to a minimum year-long mentoring commitment, and ideally a long-term professional relationship with the mentee to include, but not be limited to, collaboration in research and other scholarly activities. Each mentor committed to the following activities: (1) visit to the mentee's academic setting once to meet with the mentee and engage in an activity that would be helpful to the mentee (e.g., view labs, review data, manuscripts, grants, research/teaching program); (2) present a research seminar to the mentee's department or college (although some mentors opted out of this component, typically for logistical reasons); (3)

regularly communicate with the mentee electronically and at academic conferences to provide guidance on the mentee's progress towards tenure and/or promotion, including feedback on scholarly/research manuscripts, grant proposals and teaching; (4) host a mentee visit to their institution, where mentees typically gave a seminar and expanded their professional networks.

Applicants were asked to submit a one-page proposal that identified the external mentor with description of their scholarly expertise; the potential for the award to initiate a long-term collaboration; a seminar topic that would be shared by the mentor with the grantee's department or college, and/or other grantee-mentor activities; and a tentative timeline and brief budget. Additionally, applicants were asked to attach a supporting letter from the external mentor to confirm the mentor's commitment to the proposed interactions. External Mentor applications were evaluated by an ADVANCE at WSU committee consisting of the Program Director and ADVANCE Liaisons based on the following criteria: (1) potential for the proposed external mentor interactions to further the professional development of the mentee faculty member, with a specific preference for proposals that focused on external mentors who were successful university scientists/scholars/teachers, with evidence of national and international reputation in the mentee's discipline; (2) probability that the proposed interactions would establish a long-term collaborative relationship between the mentee and the external mentor; (3) potential for the project to enhance the tenure and promotion success of the mentee.

ADVANCE at WSU provided financial support for the visit exchanges, as well as a small honorarium for the mentor (total award up to \$5,000), with all proposal meeting criteria described above funded. All external mentors were located at U.S. institutions except three (one was from Thailand, one from Singapore, one from Scotland). External mentors came from 33 different academic institutions, plus two who worked at research institutes. Most external

mentors were full professors, and 55% were female. The average ADVANCE at WSU External Mentor award was \$4,118 (range \$2,729-\$7,000), including an honorarium of \$750 that was offered to each external mentor upon completion of grant activities.

Participants

Forty female faculty in STEM related fields took part in the External Mentor Program at WSU, supported by the NSF ADVANCE IT award between 2009 and 2013. Participants (29 assistant professors and 11 associate professors) represented a wide range of disciplines from the following colleges: College of Agricultural, Human, and Natural Resource Sciences (n=5), College of Arts and Sciences (n=19), College of Veterinary Medicine (n=8), Voiland College of Engineering and Architecture (8). All forty participants provided ratings concerning satisfaction with the program and effectiveness of the External Mentor experience. In addition, we examined research productivity as evidenced by grant proposal submissions to external funding agencies. Specifically, grant activity following participation in the External Mentor Program was considered, in terms of numbers of proposals and dollar amounts, for both submitted and received grants. A subgroup of participants (n=10) selected to represent a range of disciplines from the Voiland College of Engineering and Architecture, College of Arts and Sciences, College of Veterinary Medicine, and College of Agricultural, Human, And Natural Resource Sciences, participated in in-depth follow-up interviews.

Program Evaluation Procedures

The Social and Economic Science Research Center (SESRC) at WSU surveyed External Mentor grant recipients (i.e., mentees) in collaboration with ADVANCE at WSU as they finished their proposed mentee/mentor project. The focus of the surveys was on the recipients' perceptions of the program, including satisfaction and usability. Mentees responded to multiple-

choice questions and were also provided with an opportunity to provide additional information in the form of short answers. The survey was administered online, obtaining a 98.6% response rate.

The qualitative portion of this evaluation effort involved in-depth interviews, conducted with 10 External Mentor program mentees. This group was deemed representative of the original (N=40) sample, reflecting a range of STEM disciplines and rank, from assistant to full professor. Faculty held assistant and associate professor positions only during participation in the program, with full professor rank attained by some at the same time of the interview. Participants were aware that ADVANCE at WSU administrators would periodically contact them for routine program evaluation efforts. We recruited participants for the qualitative follow-up portion of this research via email invitations, and when they positively replied, a date and time for the interview was established. Nine out of 10 that were contacted agreed to take part in the interview. This research was approved by the WSU Institutional Review Board, and all participants provided informed consent and agreed to be audio recorded prior to their participation.

We used the method of semi-structured, conversational interviews to obtain more in-depth understanding of the faculty members' external mentoring experience. The vast majority of interviews took place in the External Mentor participant's office on the WSU campus. One interview was conducted in the ADVANCE at WSU office on campus and one via email due to geographic distance, as this participant was away from WSU at the time of the study. The interviews were completed over a two-month time period during late Spring and early Summer 2017. Faculty members responded to 11 open-ended questions that pertained to their experience in the External Mentor Program (see Appendix A). Follow-up questions were asked as needed (e.g., if greater detail was required to obtain a complete response).

Faculty interviews were 29.53 minutes in duration on average. All interviews were transcribed using SSL-secured audio/video transcription tool *Transcribe*. Participants were labeled during transcription ‘Participant A, B, C’ and so on to protect their identity. Any names of actual persons or places (including universities, cities or states) were redacted in the interview transcriptions to avoid inadvertently disclosing identities of participants. Transcriptions were then coded for key words and themes related to the guiding research question(s) of the project.

Results

Survey Data

SESRC External Mentor survey data are summarized in Figure 1. All items relied on 4-point response scale: Not at All, Slightly, Mostly, and Highly/Completely; with the 5th response option of “Don’t Know/Not Applicable (NA)”. In contrast, questions about career advancement asked mentees to rate the impact of program participation, so whether it was “Not at All”, “Slightly, Mostly”, or “Highly” impactful. The remaining questions were formulated around agreement - the extent to which mentees agreed (Not at All, Slightly, Mostly, or Completely) that they would: recommend the program to others, were satisfied overall, and felt the program met their expectations.

When asked how impactful the program was with respect to grant writing and reaching overall career goals, most mentees indicated that the External Mentor Program was Highly/Mostly impactful. A majority of mentees indicated complete agreement with the statement describing personal benefits, and the fact that their department chairs were supportive of participation. Importantly, mentees felt largely satisfied overall, that the program had met their expectations, and that they would recommend program participation to others. However, these impacts were not universal, insofar as work-life balance and teaching were not generally

addressed in the context of mentor relationships, with less than half of participants indicating benefits in these areas. Of interest, benefits to the mentees' departments were viewed as minimal, and mentee' ties to WSU were not viewed as strengthened as a result of the External Mentor experience. Although we did not include specific questions addressing networking opportunities, when asked about additional benefits of External Mentor Program participation, network-related themes were mentioned most frequently (9 out of 13 responses), suggesting these are critical to program success:

- R1 New connections in a new field.
- R2 Gaining invaluable advice on how to manage collaborations with faculty, both within WSU and outside collaborators.
- R3 I recently applied for professional leave. My mentor was helpful in regard to reviewing my application and providing feedback as well as writing a letter of support.
- R4 The external mentor program was most effective for me in establishing collaborations outside WSU.
- R5 I was able to meet, through my mentor, other women who have been successful at work/life balance. This was very informative. I have also learned how enriching some collaborations can be.
- R6 Helped me feel more qualified to work on possible research with others in this field.
- R7 It opened up a possible sabbatical year at Stanford.
- R8 The networking aspect of this is extremely important. One noticeable benefit this has had was to introduce me to an entire department (well, those that attended my seminar and spoke with me in one on one meetings) at a prestigious research University. I made new contacts, not just with my external mentor, but with others, that I expect to have significant impacts on my scientific reputation, all in positive ways. What I mean is that my research and program are now known to those scientists and their students and they can suggest me as a peer reviewer of their manuscripts, grants, etc.
- R9 Access to opportunities (invitations to conferences and meetings, introductions to other leaders in the field).

The observed pattern of results thus indicated targeted benefits for participation in the mentorship program, and that the External Mentor program had a positive impact among the participating faculty overall, albeit not universally with respect to the survey indicators.

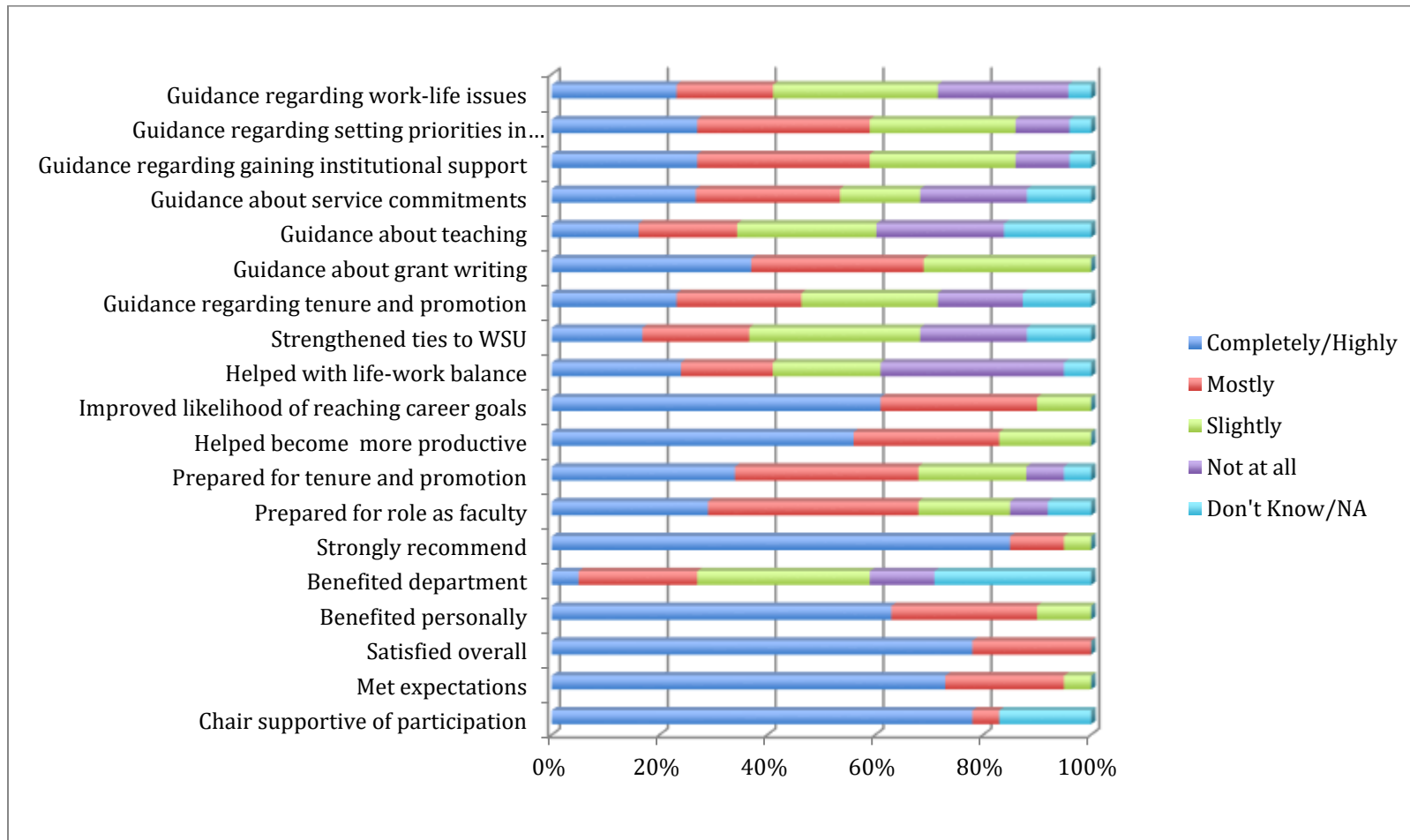
External Grant Submissions

Importantly, the benefits of External Mentor program participation have translated into grant productivity. The WSU Office of Research supports a grants database that contains all proposals and awards by principal investigators from WSU. This database was accessed to obtain objective markers of grant writing productivity and success following completion of the External Mentor program; pre-program baseline data were not available for the majority of participants, who were just starting as assistant professors at WSU (n=29). Of 40 participating female STEM faculty, only 1 did not generate any grant proposals after completing the program. For the remaining mentees, grant writing efforts were impressive: (1) Mean number of submitted proposals = 12 (range 1-33); (2) Mean amount of funding requested = \$4,692,248.08 (range \$4,501.00 to \$19,659,218.00); (3) Mean number of grants received = 4 (range 0 to 22); Mean amount of funding received = \$686,453.13 (range \$0.00 to \$745,6044.00).

Cases of Program Failure

Despite these generally positive outcomes of the external mentor grant program, three of the 40 mentor-grantee relationships could be described as failures: in two cases, the mentor “dropped off the map” well before completing the year-long interaction (i.e., stopped responding to emails or refused to commit to previously agreed-upon activities), and in one case a mentor encountered severe conflicts at their institution that (the mentor indicated) made continued interaction with the grantee unwise. In several other cases, difficulties were encountered (e.g., due to mentor or grantee health issues), but allowing extensions for grant completion and changes in activity plans were typically sufficient for enabling grantees and their mentors to eventually make good progress on their stated goals.

Figure 1. WSU External Mentor survey summary statistics (N=40).



Analysis of Themes

To enhance our understanding of faculty mentees' experiences with the ADVANCE at WSU External Mentor program, and gauge the program's impact on their professional development, additional qualitative data were collected in the form of in-depth interviews. This portion of the study was largely exploratory in nature, yet some a-priori expectations concerning themes, based on the SESRC survey findings, could be developed. As noted, survey results indicated that work-life balance and teaching did not surface as items that were meaningfully addressed in the context of mentor relationships, as few participants indicated that mentors benefited them in these areas. As network-related themes were mentioned most frequently as an added benefit in the SESRC survey "additional information" responses, these were also expected to emerge in the context of in-depth interviews, further elucidating the nature of this important potential program benefit. Thus, the qualitative interviews were conducted to enhance our understanding of the External Mentor Program benefits not fully discernable on the basis of quantitative information.

Analysis of data occurred by "reducing the information [from the interviews] to significant statements or quotes" (Creswell, 2007, p. 6) and then combining those statements into themes. This approach allows for a *textual description* (Fairclough, 2003) of the External Mentor Program experiences, meaning that transcripts were gleaned for words, sentences, and sentiments that illustrated participants' experience and the meaning ascribed to these. Theme reduction efforts are inherently selective, and we were primarily interested in the effects or efficacy of mentoring as a strategy for increasing professional opportunities to aid in retention/promotion of women in STEM fields: (1) How does the WSU External Mentor

Program support mitigation of barriers in their role as STEM faculty? (2) What functions or aspects of the program were most crucial to this process?

First, areas of impact for mentoring emphasized in the existing literature were identified (for readings, see: Bilimoria et. al, 2008; Blickenstaff, 2005; Gibson, 2004; Law et. al, 2014; Mundt, 2001; Ginther, 2015; Ginther et. al, 2016). Second, all transcripts were reviewed line by line by the 2nd author (CB) to identify words, phrases, sentences, and statements that could align with areas identified in the literature, followed by discussions with 1st (MAG) and 3^d (AW) authors. Four essential themes emerged following this process, speaking to the benefit of the ADVANCE at WSU External Mentor Program: *validation, collaboration, access and networking*, and what we had labeled a “*trickle down*” effect. These major themes are non-hierarchical and not mutually exclusive but rather overlap and encompass several subthemes discussed in more detail below, with examples from the interviews.

Interview Themes

Theme I: Validation

A majority of the faculty women mentioned how their mentor ‘validated’ or provided *validation* for their career, their work and family decisions, and their work identity or desire to be viewed as an expert. This also came across in sub-themes of ‘support’ ‘confidence’ and ‘permission’:

“I think I feel more confident in the science that she's taught me and you know what's really cool, too? She emailed me, like, last year and said ‘Can you read this manuscript? ‘Cause you know this better than anyone. I'm trying to write about’ -and I was, like, floored... so it... and coming from her in particular, ‘cause she was up here [gestures hands upwards to indicate high status] and so it made me feel like I had expertise. I'm a scientist.”

Similarly, one of the participants contemplated her experience with her mentor in this area, relating an issue that she feels is quite common for not just women in STEM, but women in general, saying:

“So, one of the problems, especially for women, from my point we are not so confident as men (laughs), I don't know why! At least I know that me and many of my friends, who are women, they are less confident than my friends who are men. Um, and uh, this... confidence, it's something that, when somebody will tell you that "you are a professional" that's how you will act, you will start building confidence. So maybe we need to hear from other people that we are professional, that we are experts.”

“It's really great to see someone who has been so successful... um, give you compliments, and she's very sparing, she does it sparingly, right? Giving compliments? And so to have any compliments from her is...she's always very supportive so I think if anything just continuing to provide the confidence that I need to keep doing what I do...”

This same theme of ‘validation’ emerged when we asked participants what is important to them when seeking a Mentor. For instance, one participant responded:

*“What the external mentorship program allowed me to do, and gave me license to do, was seek a mentor that wasn't in my field, and was someone I was intimidated to interact with to help me grow in a direction of a particular field. And that's what that program let me do that I would have never have done by myself and she has been academically as well as um, personal--talking about other issues *being a woman in science, or just being in science*, has been amazing as well.”*

And, another participant noted that due to the perceived lack of support she was receiving from her department as a faculty woman, she sought a mentor that she could talk to without feeling judged:

Participant: “Um... hmm... [long pause] you know so, I think that um, what, what would have been important, what I was missing, was to have somebody that I can really talk to without feeling judged. And I did not have that here...o.k.” [begins to tear up].

Interviewer: “O.k. understandable [pauses] do you feel... so did you get that out of your external mentor?”

Participant: “I did get that out of her, yes. And that was really important, yeah. Just to have someone for conversations and also, *she was a woman... who somehow, was facing the same challenges it was actually, it just felt like a lot of moral support and kind of, you know, have someone to talk to and kind of... see that you know, other women have similar issues and you know get support there, so that was, that was really important to me.*”

Finally, one faculty member noted the main benefit she received from participating in the

program was an increase in confidence, and the permission to take credit for her work:

Interviewer: “Regarding the ADVANCE program, did your participation increase your scholarship productivity, so for example grant-writing or publications?”

Participant: “*No. But, what it did do was increase my um... confidence. So, my scholarship--I think my confidence about my scholarship has always been pretty high but my confidence in my own ability... my external mentor pointed out to me because I gave a talk at her department, she pointed out to me that I have a tendency to say "we, we, we, we, we, we" and I give credit to the people in my group and I don't give myself enough credit, and so three days with her asking me why am I famous, what makes me special, I should say "I" more which was way outside of my comfort zone, um, I had to practice doing that and now I give that advice to other women and I can't even believe it.*”

Theme II: Collaboration

The word ‘collaboration’ was used 45 times across the interviews, which makes this an important theme for our results. The ADVANCE External Mentor Program provided an opportunity for collaboration and a collaborative context for participants, and was especially useful from an interdisciplinary perspective. For example, one participant talked about her collaboration in this way, also raising subthemes of confidence and support:

“I have much of a broad view of history now behind me that I can actually see patterns, and kind of um... be more confident in myself. But also, I think I am less scared to contact people that, um, I don't know for collaboration and I am definitely less scared to do that. And I think not only given that's what prevented me--this program was explicitly for overcoming that issue, and how positively she responded. I've never contacted people cold [laughs] and sometimes it works out and sometimes it didn't, it just ended

there was no chemistry in that interaction, but I think I definitely have less fear of doing that, I've done it!"

The importance of collaboration was also emphasized as a means to increase grant and publication opportunities. One participant spoke to her reluctance to collaborate in favor of establishing herself as an independent researcher, prior to her Mentor encouraging this aspect:

"[T]he person that I ended up picking for my ADVANCE mentor was a faculty that I was, um, that I knew well in graduate school. And I think he was always there to offer to help but I just never asked and again it might have been a pride thing, I can do it all on my own, and also the emphasis on the--you need to establish yourself as an independent researcher. If I--I know it--I know things have changed a little bit in terms of that, in terms of grant funding etcetera, more grant availability is based on collaboration. But it could have been my own naive idea of what it was I needed to do."

This same participant mentioned later in the interview the benefit of taking the advice to collaborate, while also speaking to an additional theme of *networking and access*:

"So now, so I have expanded--since the ADVANCE--I have now collaborations with [name] in the sleep lab over in [city name] and [name] who is at [name of institution] so these are... I think probably before I wouldn't have branched out to them, maybe because of that naiveté, and just talking to [Mentor name] and kind of realizing like, "wow!" and being more exposed to his collaborations and he was encouraging with collaborations, sometimes he would say "you shouldn't work on this with me, you should go over here" so I think in a way he kind of did that. I just know that post ADVANCE I have collaborations now whereas pre-ADVANCE I didn't."

We also asked each participant about ways in which their participation in the ADVANCE at WSU External Mentor Program increased their scholarship productivity or grant-writing. Here, collaboration, as well as networking and access, emerged as important to providing exposure to different approaches to research:

Participant: "Oh I ended up getting a super huge grant as a consequence of that, yeah, yeah!"

Interviewer: "Oh great!"

Participant: “Yeah, and in fact that program is just ending I think this year, so. It ended up being really, really good uh, experience for me. And it was good not necessarily-- I mean, funding is always nice, but it was also good because the type of funding, *it was um, a really large center that involved a lot of other uh, universities and it was my first experience working in a large collaborative um, type of center. And so, it was a very good experience to observe how that worked and um, kind of what the impacts were on science and education and so I feel like I learned a lot from participating in it. Um, you know, certainly my scholarship and my funding has increased by that, but I would say that for me personally I found the value, the larger value was, um... was experiencing a different way of doing research as a consequence of participating in this really large center.*”

Another sub-theme under collaboration concerned *interdisciplinarity* of the research mentees were involved in, with the support of their mentors:

“I guess because of this, I'm much more--I used to think, getting back to this collaborative research--I used to think that if I was going to study a particular area I had to be, I had to really know it inside and out, right? And that's how we're trained as academics. But when you do interdisciplinary projects you can't know everything inside and out. And so, learning to trust your collaborator and realizing that you have strengths, and she has hers and he has his, and we come together, and we have enough of an overlap to learn about each other's fields enough with enough to be able to do something integrated and bigger than it would be... I can trust them to...to do their part and do it well. Um, and so...that's a change in my approach in how I go after uh, how I research things is that, is that...is just to realize that we can do our work together, and I don't have to learn everything in their field to be able to do it, I can trust them, so, it's been good.”

Another participant was able to expand her research, in conjunction with her mentor, into a related area: submitting additional grant proposals, while also positively impacting her department:

“I've been on other grants--like the grants I've submitted since then do contain the element of what I work on with this mentor, it's just taken a different direction. The field was immunology and I work on stress and wildlife and she works on immunology of amphibians which is one of the animal groups I work on, and so like I've taken on a little more ownership of being able to do that science, and have flavors of it in current grant proposals so like--I haven't been funded but have been invited for full proposals and um, so I feel like

it's definitely contributed to my research program. So, I feel like its contributed a dimension of my research program that I definitely would not have... so I guess that's part of the impact in the department."

Theme III: Networking and Access

Beyond potential collaborations, networking and access were central features for grant recipients, in terms of having access to networks and people outside the university for possible collaborations, as well as access to grant funding, conferences, and other opportunities thought to be out of reach. One faculty member stated that she was trying to branch out of her field of study, and the External Mentor Program provided access to a conference to which she would not have normally gone, thereby extending her collaborative network, and ultimately her productivity:

"I had a small grant to reach out to a mentor at [name of University] a female um, full professor there, she was associate professor at the time. Um, and it funded the two of us to go to a conference that I wouldn't normally would have gone to because I was trying to get into a different area and she was in this different area and I felt like by getting into this different area I could really give myself a competitive advantage cause it's very hard to get funding...in my area where I was trained, it was saturated basically saturated there's too many people researching in that area. So, it provided me--both of us to go to this other conference... And we've since written one of few successful grants together and we've developed a relationship, we co-publish, we probably have three to five publications ongoing right now together that we're working on submitting or have submitted."

As a result of working with her mentor, the faculty member cited below had access to others in the field, so that she was well-positioned when it was time for tenure review:

"When I came to her lab, she introduced me to many people in their department who I personally didn't know before and it was very important for my network and one of the reasons for example, that uh--we usually we know about people with whom we collaborate right? And for tenure recommendation, we need to get recommendation letters, but the letters cannot be from people with

whom you collaborate, so they have to get from people from the field, and these people should know us somehow but there should be no collaboration, so no conflict of interest. So, with her increasing this amount of people who I knew in the field was very important, for future, so then when I was asked to give a list of people who can give a recommendation, there was--I [had] more names than I did without her introducing me to these people.”

Another faculty member spoke to the access to opportunities she received as a consequence of networking and collaborating with her mentors—using the term “exposure” in reference to how she was then able to look at her research in new ways. And, a different participant mentioned that her mentor opened “the door” for her to connect with new people she would not have met otherwise:

“I met a lot of people from a lot of different universities, and so that, from a networking perspective was really good and I still interact with some of those people and, and um, and so that was, that was, um, I think really important um, and also uh, that project was pretty interdisciplinary and so it paired together like chemical engineers with chemists, and so it was really relevant and good for me to see, um from a networking--well, it was good for me to see different ways in which to try and solve problems and different ways in which different disciplines try and tackle problems... I think that it was more about exposure to me personally, it was about exposure to different disciplines and different modes of doing research that was really um, most impactful.

“I’m a very friendly person and I easily talk to people, but she introduced me and had me meet you know when I was at her institution with all of her friends and because, um she was introducing me and her credibility was, was um, leading--opening the door for me, I felt like I talked to quite a few people that had I gone there on my own or if had been invited by someone else, I wouldn’t have met those same people and all very, you know, very...successful people.”

Theme IV: “Trickle-down” Effect

Finally, an unforeseen benefit of the ADVANCE at WSU External Mentor Program that went beyond collaboration, increased access to networking, and interdisciplinary perspectives on research, was defined by a “trickle down” effect: the “lessons learned” and the program’s

positive impact extended to students in participants' laboratories. This aspect took many forms, for instance, one graduate student benefitted from the faculty member's relationship with their external mentor by earning a postdoctoral appointment in the mentor's laboratory:

Participant: "I have a lasting relationship with this woman. My graduate student--my first graduate student who graduated in December--is postdoc-ing with her..."

Interviewer: "Oh good!"

Participant: "So, I mean, yeah! So, it created a pipeline for my students. And I haven't begun to talk about like how I figure out how to mentor my students, mentor women. But that was a great opportunity in having that relationship established over the time she was in graduate school, lays the groundwork for you know, when it came time for her--there was a position open, she applied and she got it and she's perfect in that position."

As this participant indicates, mentoring others, especially women, in turn, represents another trickle-down benefit of the program, positively impacting her department:

"It allowed me to actually mentor a master's student, that expertise I learned from that exchange that you know that I felt comfortable to actually have a student do a project in that area of science. I didn't have that expertise before and so... there's a master's degree candidate who is employed in [name of state] because of that external mentorship, so I think that has definitely added to my research productivity, and um my ability to mentor students and educate students in the department."

A different participant also had a graduate student who benefitted from her connection to an external mentor:

"She [the Mentor] came here, she spent several days here and she met with my graduate students we talked about how to establish the lab, how to develop graduate students, she actually invited one of my graduate students to come to her lab..."

The same faculty participant who mentioned that her mentor opened "the door" for her to network with highly successful people in the field, talks about how she now serves others in the same way, saying:

“[M]y network can be important for my colleagues and certainly for the students in our department... *I try to do that now on the other side where if I have someone coming through I try to make sure that they meet with some people that may have some influence on them, or, just so they have practice talking to someone at that success level.*”

The relationships that one faculty member established with her mentor had far-reaching benefits, from increasing personal productivity to providing a broader network of scientists with whom to interact:

“What it did is it started a relationship. And we've since written one of few successful grants together and we've developed a relationship, we co-publish, we probably have three to five publications ongoing right now together that we're working on submitting or have submitted. Um, and you know more than that if you think of them all. And we have annual meetings where we meet in Seattle cause it's easy to get to... and we spend a couple days just hashing things out and we have a lot of students that we, that she co-advises and we all show up, and so...it's been very good.”

The interdisciplinary perspective provided by the mentor allowed one participant to share this viewpoint with her graduate students, and inspired her to start an interdisciplinary reading group. One of her undergraduate students was successful in obtaining a graduate school position as a result of this exposure:

“I hope for students who are working with me, and I think we discussed about this, not only you're learning math, *I also suggest and recommend them to take courses in other disciplines.* Say you're interested in infectious disease, right, and you really want to *go to other department and take the related like course,* that should be helpful... so, like last year I got a student from the neuroscience department and he was a senior and so of course where I could help him was of course to start developing [this] stuff, and *he got several offers I think eventually he received an offer from [name of University], he just moved there for a PhD program.*”

As part of the program, mentors were invited to give colloquium presentations in the participants' department. Participants indicated that these presentations resulted in a trickle-down benefit to other faculty members, graduate and undergraduate students.

Overall, mentees revealed that participation in the ADVANCE at WSU External Mentor Program had a positive impact on their sense of self and professional identity, ability to collaborate and network with others in the field, and access to grants and other opportunities for scholarship/advancement, as well as fostering more successful mentoring relationships with their own students. One faculty member summed up her experience in a way that was indicative of the sentiment expressed by many other External Mentor Program participants, which is befitting as a conclusion here:

“You're in the moment, or you're feeling so weighed down with your failures that um, without external people telling you "Hang in there! This is what I did..." and to see where they are now is very inspiring, and sometimes you have to find people to help you be inspired. So, I think this program has definitely helped me find these mentors that I was receptive to seeking but otherwise would not have made those contacts, so it's been really, really important.”

Discussion

We set out to examine an External Mentor Program, expecting to find that women faculty in STEM fields would benefit from this experience. The evaluation was prompted by the need to provide support to women in STEM to increase representation via effective retention/promotion efforts, and existing evidence indicating that mentorship programs can play a critical role in career advancement for women faculty in STEM-related areas. Results of this study demonstrate that collaborating with more senior colleagues outside of one's university and gaining access to their networks both broadens research opportunities and results in enhanced productivity, based on self-perceptions and objective markers. Qualitative data obtained via in-depth interviews

indicated that participants benefited from an increased sense of confidence, and reported feeling validated by the mentorship experience. This validation is critical in light of the confidence gap noted for women scientists in STEM fields (Ben-Shachar, 2014), and can be expected to contribute to persistence, as previously reported for women in engineering (Frehill et al., 2006). Gibson (2004) noted the importance of such validation, as faculty members sought to be perceived as both talented and highly capable of performing their various roles. Importantly, faculty involved in mentorship relationships demonstrated enhanced research productivity and reported greater career satisfaction (Skeff, Stratos, & Mygdal, 1997; Zinn, 1997).

According to Gibson (2004), women may be particularly receptive to mentorship relationships. From the interviews, we found that many of the faculty mentioned they wanted to reach out to collaborators and mentors prior to participation, and that this program allowed or gave permission for them to do so. As noted, collaboration was highly valued by all of the participating faculty. Studies suggest this factor is now becoming increasingly important to scientific innovation (Bear & Wooley, 2011). Gibson (2004) noted that due to its high perceived value, mentoring should be made available in academia as a means of supporting career advancement of all women faculty. The provision of mentoring may contribute to overall campus climate improvement, which is important in the retention of women faculty in STEM (Gibson, 2004). As the production of science (Bear & Wolley, 2011) becomes more central to our society, collaborative mentoring relationships will be critical in this endeavor.

There were more targeted benefits as well, with respect to productivity and reaching career goals. The open-ended portion of the survey revealed that participants gained considerable benefits in terms of networking and growing valuable connections to other leaders in their field of study. Interviews also indicated that networking with others, and access to grant and

publication opportunities, was vital to the external mentor experience. The latter finding is especially important given that some women faculty tend to feel more isolated than male counterparts (Gibson, 2004), in part likely due to under-representation. This isolation likely creates barriers in reaching out to others, or may obscure other career-enhancing opportunities. Exposure to mentors' networks has been described as one of the principal benefits of the mentoring relationship for the protégé (Cho, Ramanan, & Feldman, 2011; Haines, 2003; Schrubbe, 2004), and results of this study further support the importance of this outcome.

Overall, despite the noted cases of program failure, participation in the External Mentor training opportunity appears to have benefited the faculty involved as mentees. At the same time, participation in the mentoring program did not appear to have widespread effects on the faculty members teaching or service-related aspirations and did not improve their sense of connection to WSU. Perhaps the latter is not surprising given that the mentors were external, from an array of academic institutions. However, we did note a sense of obligation to participants' graduate students in their narratives related to what we have termed the "trickle-down" effect. Whether this drive to mentor others could relate to a greater connection to WSU is not clear. As only one of the External Mentor participants has relocated to another institution after taking part in the program, some retention benefits may have been realized.

Limitations and Future Research

Although all STEM women faculty at WSU are eligible to apply for the External Mentor Program, participation is voluntary. Understanding differences between participants and non-participants in the External Mentor Program and the collection of pre-post program participation data would help to shed light on these issues. We did not attempt to address such differences in the present investigation because of considerable variability in baseline across participating

faculty: some were new to WSU, others were in transition to professor rank. Future research could focus on mid-career women faculty and obtain viable baseline estimates on productivity, which would partially address this limitation. We make this recommendation mindful of the fact that a direct comparison between control and treatment groups represents the gold standard of experimental design. However, obtaining a suitable control group is likely to be a challenge in future studies as well - not uncommon with real-life intervention scenarios. Random assignment, even in the wait-list comparison group context, would inevitably result in withholding training opportunities, potentially during key career transition periods. At the same time, there are no immediately available quasi-experimental alternatives, given that examining outcomes relative to non-participating non-STEM departments would not provide an appropriate comparison of productivity due to differences in expectations for grants and publications. Moreover, comparing participating women STEM faculty to those choosing not to participate does not provide an adequate benchmark. Particularly motivated women, already on a rapidly rising career trajectory, may self-select for participation. Alternatively, participants may be those who are experiencing particularly significant challenges in their career development. In either case, comparing participating and non-participating eligible faculty is fraught with threats to internal validity, because of the inevitable self-selection involved. With these complexities in mind, the pre-post repeated measures design appears to be best suited to further address questions related to the effectiveness of External Mentor programming.

A number of additional limitations should be noted. We did not measure climate-related benefits directly, and these should be considered in future research. Herein, we simplified *STEM* as a singular subject area (Blickenstaff, 2005), rather than looking at the various disciplines or departments under which we define distinctions in science, technology, engineering, and math.

Individual women faculty likely experience mentoring differently depending on their department environment (e.g., number of other female faculty likely matters with respect to feelings of isolation), and this context should be considered as a factor in the future. Moreover, our findings do not speak to benefits specifically for female faculty in disciplines/departments that lack a meaningful representation of women, or effects of intersectionality on participation – limitations to be addressed by future research. Information concerning the mentors' experience, or other mentoring resources mentee faculty may have accessed in addition to the program was not obtained and should be gathered in future efforts.

Lastly, one of the major goals of the program was to support grant productivity of participants because grant awards are necessary to build successful research programs in STEM disciplines, are simple to quantify, and are linked to other measures of faculty productivity such as numbers of graduate students and quality (and quantity) of publications. It should be noted that the external funding figures presented in this study are largely descriptive in nature. Nonetheless, it is notable that only one of the mentees did not submit a grant proposal after engaging with an external mentor, and that the rest of the mentees were productive both with respect to submissions and successful attempts at securing funding.

Conclusion

Despite these limitations, to be addressed by future research, our findings have a number of policy and practice implications for supporting scholarship and career advancement of women faculty in STEM fields. First, an External Mentor Program can be offered in an effective manner with minimal oversight of mentorship activities, obtaining high ratings of satisfactions and meeting expectations. Asking mentees to approach a prospective mentor may seem demanding, yet our findings show that faculty supported in this experience benefit from the exposure to a

more senior scientist at a different academic institution. Second, career development benefits, although targeted in nature, are critical in their relevance to productivity and career-related goals. The latter is further supported by objective data obtained from the WSU research office, which indicates that participants were overwhelmingly active and largely successful at grant writing. Moreover, network-building benefits were consistently reported by participating faculty in both the online survey and semi-structured interview. This aspect is essential because of its potentially transformative nature, in a sense opening doors to a variety of collaborations. The networking benefits may also be critical to overcoming the confidence gap frequently cited as a barrier to career advancement for women faculty in STEM disciplines (Ben-Shachar, 2014). The minimal investment required to support the mentoring relationship, together with multiple advantages cited, led to the institutionalization of the External Mentor Program at WSU, currently funded by the Office of the Provost. Further program evaluation efforts are underway, as we tackle questions not addressed by the present investigation.

Overall, results of this study provide support for external mentorship as a strategy for encouraging retention and advancement of women faculty in STEM fields. It should be noted, however, that external mentorship represents just one strategy, or “piece of the puzzle”, rather than a complete solution to a complex and long-standing issue affecting the scientific community at large. Nevertheless, overall satisfaction with the ADVANCE at WSU External Mentor Program was high, mentees reported that their expectations were met, and they expressed a high degree of consensus regarding recommending participation to their colleagues.

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Appendix A

Faculty Mentee Interview: ADVANCE at WSU External Mentor Grant RecipientsIntroduction by Facilitator

Hello, my name is _____ and I am a PhD student at Washington State University. Thank you for taking the time to participate in an interview. I am here to learn about your experience as a participant in the External Mentor Program, including the nature and extent of support you received from your mentor. There are no right or wrong answers to the questions I am going to ask. You do not have to answer any question that you don't want to, and your name will not be attached to any comment that you make. You can stop the interview at any time as well.

As you know, the goal of the External Mentor Program is: "to further professional development by working with off-campus science and engineering leaders, with special emphasis placed on mentorship that supports and/or communicates awareness of barriers that exist for woman in STEM disciplines." Participants have shared their views via surveys regarding their perception of the Program, and now we'd like to delve a bit deeper into your own thoughts of the Program. Please note that this session will be recorded to ensure we capture your words and ideas. The interview should take approximately 30 minutes. Are you o.k. with being audio-recorded? Do you have any questions before we begin?

1. Work Culture: Tell me about your experience working in [dept. or college?] What is it like working here? What kind of network of support do you have? – or – Tell me about the network of support you have?
2. People talk about women in STEM in a variety of ways. What does it mean to you to be a woman in a STEM-related field – or – what does it mean for you to be working in STEM?
3. Prior to ADVANCE external mentorship program, during your tenure here or during your academic career, what interactions have you had with mentors? How did the mentorship come about? What did you like/not like about your experience?
4. What is most important to you in a mentor? – or, what is most important to you when seeking a/n [external?] mentor relationship?
5. Departmental support: In what ways was your participation in this grant program supported? How do you know? What follow up, if any, has your department head or chair had with you regarding the Program?
6. Productivity: Regarding the ADVANCE Program, did your participation increase your scholarship productivity, for example grant-writing or publications? In what ways? What about networking? - or - In what ways did your participation increase your network, or ability to network with others in the field? In what ways would you want to see this aspect of the Program enhanced in the future? – or – In what ways do you think the Program could facilitate this aspect better in the future?
7. Departmental contribution: Do you feel your participation in the ADVANCE Program had an impact on, or made a contribution to your department? Why or why not? In what ways do you feel the Program could help facilitate this aspect better?
8. Emotional and Work/Life support: Regarding the ADVANCE Program, in what ways, would you say, did your mentor support your personal and/or life commitments, if s/he did so?

9. Impact of mentor: Do you feel that your mentor changed the way you view yourself? Has this experience affected your career goals or other life plans? Has it affected the way you approach your work and life?
10. If you had a preference, would an internal or external mentor be more beneficial to you? In what ways? -or - If you were to seek out a mentor in your field, would they be internal or external to University? Why?
11. If you could change anything about the External Mentor program at this point, what would it be and why?

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