Spring 2020

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Citation Details

Keller, T. E., & Lindwall, J. (2020). Investigating a Multiple Mentor Model in Research Training for Undergraduates Traditionally Underrepresented in Biomedical Sciences. Understanding Interventions, 11(1: The Use and Impact of NIH-fueled Resources for Mentoring—Reports from the Field), 12476.

Spring 2020
Volume 11, Issue 1

Investigating a Multiple Mentor Model in Research Training for Undergraduates Traditionally Underrepresented in Biomedical Sciences

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Abstract

Models of persistence and success in undergraduate research training emphasize the importance of engagement and integration across social, educational, research, and career settings. Students are likely to benefit from multiple sources of mentoring to meet their multidimensional needs for support across these domains. As part of a comprehensive training initiative for traditionally underrepresented students aspiring to careers in biomedical research, BUILD EXITO implemented a multiple mentoring model matching each undergraduate scholar with a research mentor, a faculty mentor, and a peer mentor. By design, each mentor has a different functional role. This study investigates whether the nature of support scholars actually receive differs by type of mentor. The data are activity records (n=11,756) generated from monthly logs on which scholars (n=223) indicated the form of support received from each mentor by selecting from several items (e.g. personal support, making connections, career advising). Analyses with repeated-measures ANOVA indicate that peer mentors are more likely to address scholars' personal lives, academic skills, and connections to campus programs and services. Career mentors focus on advising related to academics, academic progress, and careers. Research mentors, although also providing career advising and addressing personal life, primarily engage scholars in research-related training activities. The findings confirm that each type of mentor provides a distinctive pattern of support for undergraduate scholars, suggesting that students in comprehensive programs emphasizing academic success, research training, and career development may benefit from multiple sources of mentoring.

Introduction

Growing evidence suggests the inclusion of diverse perspectives is important for enhancing the quality of health-related research, improving the provision of health care, and addressing pervasive health disparities (McGee Jr, Saran, & Krulwich, 2012; Mitchell & Lassiter, 2006; Valantine & Collins, 2015). However, the recipients of major NIH research grants are not representative of the diversity found in the general population (Ginther et al., 2011). To diversify the NIH-funded

research workforce of the future, NIH established the Building Infrastructure Leading to Diversity (BUILD) initiative to promote innovative research training for undergraduates from backgrounds traditionally underrepresented in the biomedical and behavioral sciences (Valantine & Collins, 2015).

Research training programs designed for undergraduates are expected to incorporate research inquiry into coursework (Bangera & Brownell, 2014; Weaver, Russell, & Wink, 2008) and provide meaningful undergraduate research experiences (Hunter, Laursen, & Seymour, 2007; Lopatto, 2007; Russell, Hancock, & McCullough, 2007). In addition, such programs are likely to be more successful if they address the multiple psychological, social, cultural, and financial factors that often pose barriers for students from traditionally underrepresented backgrounds pursuing biomedical majors (Gazley et al., 2014; Hurtado et al., 2007). Evidence suggests that academic persistence and success among underrepresented minority students in science is associated with overcoming prejudice and stereotype threat, developing an identity as a scientist, developing a sense of science self-efficacy, having peer social support, and engaging in campus activities and opportunities (Chang et al., 2014; Chemers et al., 2011; Syed, Azmitia, & Cooper, 2011).

Conceptual models of student persistence and success emphasize the importance of engagement and integration across educational, social, and research environments (Kuh et al., 2006; Reason, 2009; Shaw, Holbrook, & Bourke, 2013). Most undergraduates have multi-dimensional needs for support, including psychological and emotional support, assistance acquiring academic subject knowledge, and guidance on goal-setting and career paths (Nora & Crisp, 2007). Quality mentoring has the potential to support student trainees across many domains linked to educational persistence and research preparedness (Wilson et al., 2012; Zaniewski & Reinholz, 2016). In fact, students tend to benefit from having more than one mentor with whom to share their social, cultural, and academic concerns (Wallace, Abel, & Ropers-Huilman, 2000). Graduate research trainees and early career academics also seek out multiple sources of mentoring to meet their distinct functional needs for support (de Janasz & Sullivan, 2004; Keller et al., 2014).

As part of a comprehensive training initiative for traditionally underrepresented students aspiring to careers in health science, one BUILD grantee, the BUILD EXITO program, proposed a multiple mentoring model in which each student is matched with a research mentor, a faculty mentor, and a peer mentor (Keller et al., 2017). In this model, each scholar is assigned a primary research mentor associated with a long-term placement in a research setting because research mentors have been identified as crucial in the success of undergraduate research experiences (Linn et al., 2015). The research mentor provides direct supervision and guidance as the student gains first-hand knowledge about designing, conducting, and communicating research. The research mentoring is project-oriented, placing priority on completing tasks necessary for conducting the research. In this respect, the mentoring reflects an apprenticeship in which the mentor instructs the scholar on research protocols and procedures, initially providing clear expectations, guidelines, and orientation to the project and then later helping the scholar develop the traits, habits, and perspectives of a scientific researcher (Thiry, Laursen, & Hunter, 2011). Through frequent contact

and joint work on the project, research mentors also help scholars to gain confidence in their research skills and develop a science identity by observing and exploring different research roles (Shanahan et al., 2015).

In the BUILD EXITO model, faculty mentors are encouraged to adopt a student-focused advising role based on a relationship characterized by a strong connection, authenticity, commitment, and genuine concern for the student (Schreiner et al., 2011). Based on understandings gained through the relationship, the nature of mentoring activities, conversations, and assistance is determined by the circumstances, interests, and goals of the scholar. The mentor offers a faculty perspective on a range of topics such as advising about courses and majors, discussing career options, identifying scholarships, strategizing about study skills, resolving roommate conflicts, addressing work-school-family balance, handling a personal crisis, and planning for school breaks (e.g., Kendricks, Nedunuri, & Arment, 2013). Faculty-student mentoring with this type of multi-purpose orientation has been shown to have positive effects on GPA, credits earned, and retention (Campbell & Campbell, 1997).

Peer mentors are advanced undergraduate students who provide personal support and serve as guides to student life and academic success (Zaniewski & Reinholz, 2016). Such mentors facilitate social integration by helping students connect to campus cultural activities, groups, and programs as well as navigate university services such as housing, financial aid, and recreation. This "near-peer" approach matches the student with a mentor who shares a similar background, but already has navigated a pathway to success (Terrion & Leonard, 2007). Such a mentor is likely to have strong credibility, as the mentor recently has achieved a goal similar to that of the scholar and understands what is involved in making it a reality (Hill & Reddy, 2007). As a role model, the peer mentor provides a concrete example that someone from a similar background can achieve what the student aspires to do (Wallace et al., 2000).

The multiple mentor model described above is predicated on the idea that each type of mentor will make a distinctive contribution to the success of a student trainee because each mentor serves a different functional role. The present study examines this premise by addressing the following research question: Are the different types of mentors offering different forms of support for students? Findings have implications for designing interventions that provide a comprehensive training experience because the resources necessary to establish and maintain a multiple mentoring model must be warranted by the specific contributions of each type of mentor.

Method

BUILD EXITO Intervention Description. The BUILD EXITO project is one of ten interventions funded through the NIH-funded BUILD initiative to develop, implement, evaluate, and disseminate innovative undergraduate research training programs to support students from backgrounds traditionally underrepresented in biomedical science (see Richardson et al., 2017). BUILD EXITO offers a comprehensive, three-year, developmentally-sequenced research training

experience designed to accommodate multiple biomedical majors and disciplines (e.g., natural and social sciences), multiple partner institutions (e.g., 2-year and 4-year institutions), and multiple student trajectories (e.g., true freshman and transfer students). Over the three-year developmental pathway, the EXITO training model weaves together multiple program components into a coherent sequence providing personal, social, academic, and financial supports to promote scholar success leading to graduate studies and research careers. Central components of the training model include an integrated curriculum, multi-faceted mentoring, a long-term research internship, a supportive environment, and trainee funding.

During the first phase of the cohort-based training program (year 1), EXITO scholars participate in several activities designed to develop their scientific interests, orient them to expectations in research settings, introduce the principles of responsible research, socialize them to the research enterprise, and prepare them for successful research internships. These activities include participation in an intensive week-long summer orientation, matching with faculty (career) and peer mentors, enrollment in a research gateway course, and attendance at weekly enrichment/professional development workshops. The program also provides scholars with a supportive environment by offering tailored academic advising, financial aid advising, a dedicated student lounge and computer lab, monthly scholar newsletters, social media platforms, and connections to campus opportunities and services.

In the second phase of the program (years 2 and 3), scholars gain direct research experience working in long-term placements with Research Learning Communities (RLCs), faculty-led teams that have ongoing, funded research projects. A month-long Summer Induction provides a supported entry to the RLC placement with twice weekly seminars that facilitate scholars in getting acclimated to working in their internships. Scholars then devote 10 hours per week to research in the RLC during the next two academic years and receive trainee financial support in the form of a monthly stipend and tuition remission. During the intervening summer, students participate in a 10-week Summer Immersion, which includes a weekly journal club, ongoing professional development sessions, and approximately 20 hours per week in their RLC. At the end of this summer, students present their research at a Summer Research Symposium for the broader EXITO community. Each scholar in an RLC has an assigned research mentor responsible for engaging the scholar in meaningful research activities, coaching the scholar in research skills and techniques, and supervising the scholar's efforts on the research project. A goal for the 18-month RLC apprenticeship is for the scholar to develop an increasingly sophisticated understanding of the research process and ultimately to make significant contributions to scientific posters, presentations, and publications.

BUILD EXITO is a collaborative multi-institutional project led by Portland State University (PSU), a major public urban university that prioritizes student access and opportunity, and Oregon Health & Science University (OHSU), a research-intensive academic health center. The BUILD EXITO network includes nine additional partners that are 2-year and 4-year institutions of higher education spanning Oregon, Washington, Alaska, Hawaii, Guam, American Samoa, and the

Northern Mariana Islands. EXITO has two parallel scholar training pathways depending upon whether students initially enroll in the program at 2-year or 4-year institutions. Community college partners recruit and enroll EXITO scholars on their campuses and implement the first phase the EXITO program model. These scholars then transfer to PSU, where they complete the final two years of the EXITO program. Scholars entering EXITO at PSU or at 4-year university partners complete the entire program at their home institutions. OHSU, which does not have undergraduate programs, hosts many scholars in RLC placements.

BULD EXITO Mentoring Practices and Procedures. EXITO scholars are matched with a peer mentor during their first year in the program. Peer mentors are advanced undergraduate students, typically with research experience, hired to serve in this role and matched with a small group of EXITO scholars (n=8-12). Peer mentors are recruited from among EXITO alumni or students involved in other research training programs (e.g., McNair Scholars, Louis Stokes Alliance for Minority Participation). Peer mentors, who are trained and supervised by the EXITO mentoring coordinator, assist with the development and delivery of the weekly scholar enrichment sessions, which provides a regular opportunity for them to meet with their assigned mentees in addition to their one-to-one meetings. Peer mentoring is focused on the first year of the program, when there is a more obvious distinction in experience between mentor and mentee, although many connections are maintained longer on an informal basis. Extensive details regarding the recruitment, hiring, training, matching, and supervision and monitoring of EXITO peer mentors can be found in Keller et al. (2017).

EXITO scholars also are matched to a career mentor in their first year of the program. Career mentors are faculty members recruited from a variety disciplines to provide general advising and support for 1-4 EXITO scholars. Career mentors are expected to have a one-to-one meeting with each mentee once a month during the academic year. Career mentors receive a modest honorarium per scholar per year, and in some cases exceptional mentors have received a course buyout for supporting a larger number of scholars (n=10-12). EXITO scholars who transfer from a community college partner to PSU are assigned a career mentor at each institution, whereas scholars at universities ideally have the same career mentor for all three years in the program. As noted, scholars are matched with a designated research mentor when they enter an RLC in the second year of the program. The RLC is responsible for identifying the research mentor when a scholar is accepted for a placement. The research mentor may be the leader of the research team or lab (i.e., Principal Investigator) or another capable team member, such as a faculty colleague, postdoc, graduate student, project director, or lab manager. The assigned research mentor is expected to meet with the scholar at least one hour per week. In addition to the research mentor, other members of the RLC research team also may provide mentoring and training to scholars.

All EXITO mentors receive a pre-match orientation to the program reviewing goals, expectations, and procedures. In addition, mentors receive training adapted from a widely used curriculum, designed for training academic research mentors of undergraduates in STEM and biomedical

disciplines, entitled *Entering Mentoring* (Pfund, Branchaw & Handelsman, 2014). This curriculum includes modules on aligning expectations, promoting professional development, maintaining effective communication, addressing equity and inclusion, assessing understanding, fostering independence, cultivating ethical behavior, and articulating a mentoring philosophy and plan. Peer mentors receive group trainings covering all modules prior to matching with mentees. Career and research mentors attend a series of combined group trainings that present two modules per training over the course of the academic year.

A core principle of the BUILD EXITO mentoring program is that making good matches is not sufficient; each mentoring relationship should have ongoing monitoring and support from a professional program coordinator (Keller et al., 2016). To manage such a large number of mentoring relationships across the multiple EXITO institutions, an innovative online platform, the EXITO Mentoring Support Network (EMSN, supported by *America Learns*), is used for maintaining regular communication with all mentors and scholars in the program. Each participant has an individual ESMN account with an associated profile that contains relevant characteristics, such as personal demographics, program status, institutional affiliation, and academic discipline. The profile also identifies each mentor matched to a particular scholar, and vice versa (e.g., a mentor may have multiple scholars).

On a monthly basis, each participant (both mentor and scholar) receives a scheduled email prompt to enter the EMSN system. On the landing page, the participant sees general program announcements and news updates. After logging in, the participant responds to a set of questions about each mentoring relationship. Certain consistent questions elicit basic tracking information about the nature and development of the mentoring relationship, such as the amount of hours of contact, the types of mentoring activities, and the quality of the relationship. Other questions can be customized to obtain specific information about the mentoring relationship or topics relevant for program improvement. Use of the EMSN system is an efficient means of tracking and monitoring the large number of EXITO mentoring relationships across multiple, widely dispersed institutions. The questions are designed to generate information about whether particular relationships are positive and productive or whether they are struggling and need support. EMSN allows the mentoring program coordinator to view and respond directly to comments and questions in participant logs. Thus, the program coordinator can suggest strategies and solutions and provide ongoing encouragement, advice, and guidance as needed.

Sample. The sample for the current study consists of 223 BUILD EXITO scholars from the first three annual cohorts (entering 2015, 2016, and 2017) who completed at least one EMSN mentoring log during the academic months from February, 2016 to May, 2018 (excluding the summer months of June-August). Scholars from all participating institutions were included. All scholars were undergraduates in biomedical majors, including biology, chemistry, public health, psychology, and many others. As shown in Table 1, over two thirds of participants were female, and based on race and ethnicity just over half were underrepresented minority students. A majority

were first generation college students, came from socially or economically disadvantaged communities, and received financial aid. A small proportion had experience in foster care.

Because the three cohorts were at different stages of the program during the months noted, the analyses reported below are based on different subsamples reflecting the number of respondents reporting on career mentors (n=206), peer mentors (n=162), research mentors (n=139), and all three mentors (n=97). For each subsample, the demographic characteristics of participants who were included versus excluded are compared to determine how representative each subsample was relative to the whole sample. Across all comparisons, three statistically significant distinctions were found. A higher proportion of participants reporting peer mentoring activities were female and received financial aid. Similarly, a higher proportion of participants with data for all three mentors received financial aid.

Table 1. Demographic Characteristics of Participants (n=223)

Characteristic	N	%		N	%
Gender			URM		
Female	152	68.2%	Yes	115	51.6%
Male	69	30.9%	No	101	45.3%
Other/nonbinary	2	.9%	No Data Available	7	3.1%
Financial Aid			Disadvantaged		
Yes	151	67.7%	Yes	121	54.3%
No	72	32.3%	No	102	45.7%
First Generation			Foster Care		
Yes	140	62.8%	Yes	18	8.1%
No	83	37.2%	No	205	91.9%

Procedures and Measures. The data for the current study are 11,756 activity records from scholar logs recorded in the EMSN system following the procedures described previously. IRB approval was obtained for secondary analysis of de-identified data from these program records.

On each monthly EMSN log, scholars were asked to respond to the following question for each of their active mentoring relationships: *"What was the focus of your activities or discussions with this EXITO Mentor this month?"* The response options provided in a drop down menu included: getting acquainted; academic advising and progress; EXITO program features and supports; advising on graduate programs; campus connections (e.g., student resources, services, opportunities); career advising or planning; off-campus connections (e.g., to another institution or a potential employer); personal life (non-finance related); skills needed for academic success; skills needed for success in research; financial concerns; financial aid; and other (which was an open text box). Students were able to select multiple activity items for each mentor for each month. Response options for research mentors did not include the item for "skills needed for success in research," but did include a list of more specific research relevant activities: reviewing the theory, concepts and questions guiding the research project; reviewing project/lab policies and procedures; coaching on research techniques/skills/equipment; working with scholar to conduct experiments or collect data; problem-solving or refining/revising research methods; analyzing data; discussing/interpreting research results; presenting results (e.g., scientific writing, oral presentations, posters); conducting literature reviews; understanding journal articles; and coaching on expected conduct or performance (e.g., professionalism).

To generate values for each scholar accounting for varying numbers of logs per scholar, a score was computed for each activity indicating the proportion of months in which the scholar engaged in that activity with a particular mentor out of the total number of monthly logs the scholar submitted about time spent with that mentor.

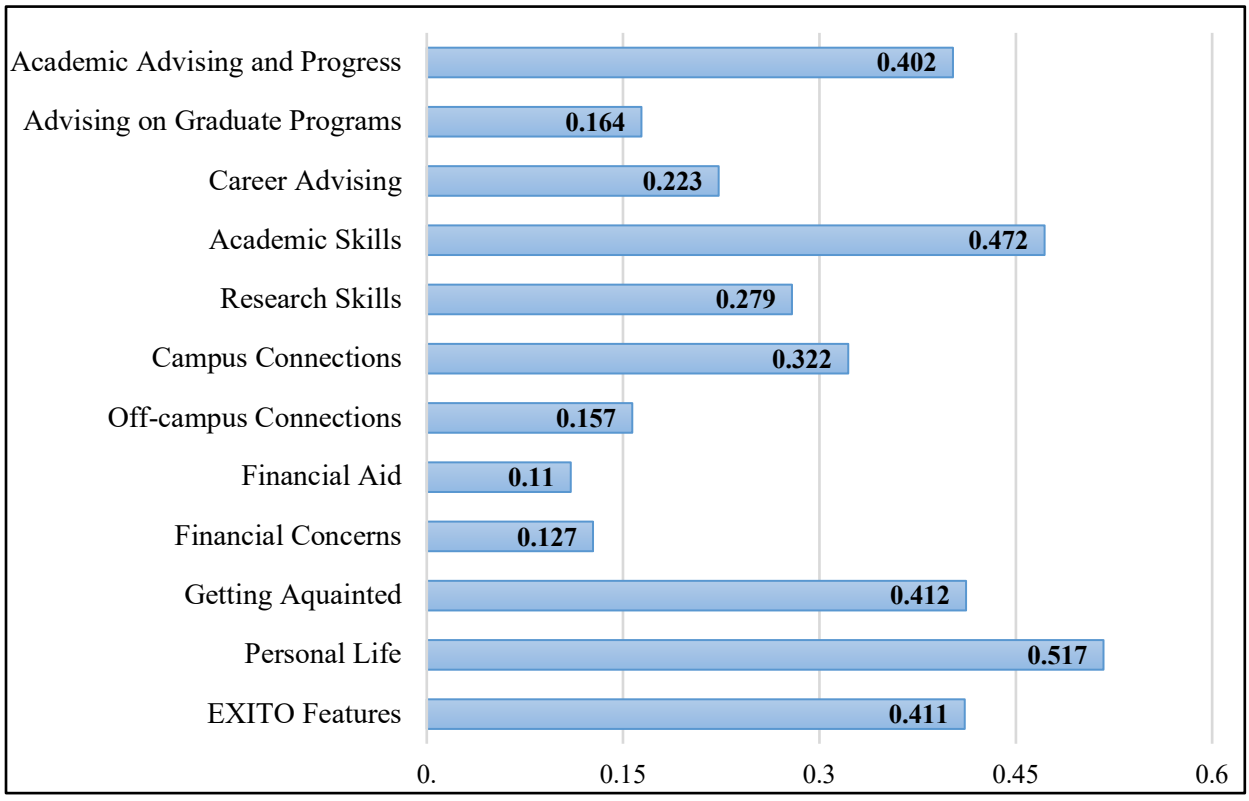
Analyses. Analyses generated descriptive profiles for each type of mentor depicting the relative mean proportion of each activity reported for that type of mentor. The primary research question involves a within-subjects design to determine whether individual scholars engage in different types of activities with each of their three mentors. Accordingly, a repeated-measures ANOVA with mentor type as the main factor was conducted for each of the mentoring activities in the EMSN log. Given the number of activities tested, the Bonferroni correction was applied to control for Type I error. Post hoc analyses were conducted, as appropriate, to identify statistically significant differences between specific types of mentors. Finally, to evaluate whether responses for research mentors differed between the general support activities (asked of all mentors) and the detailed research activities asked only for research mentors, the mean proportion across general activities was compared to the mean proportion across research activities using a repeated-measures t-test.

Results

The descriptive profiles presenting the mean proportions of activities with each type of mentor show distinctive patterns of support offered through the different mentoring relationships. As seen in Figure 1, on average, over half of the scholar logs reporting activities with peer mentors indicated that topics related to the scholars' personal lives had been addressed. Other high fre-

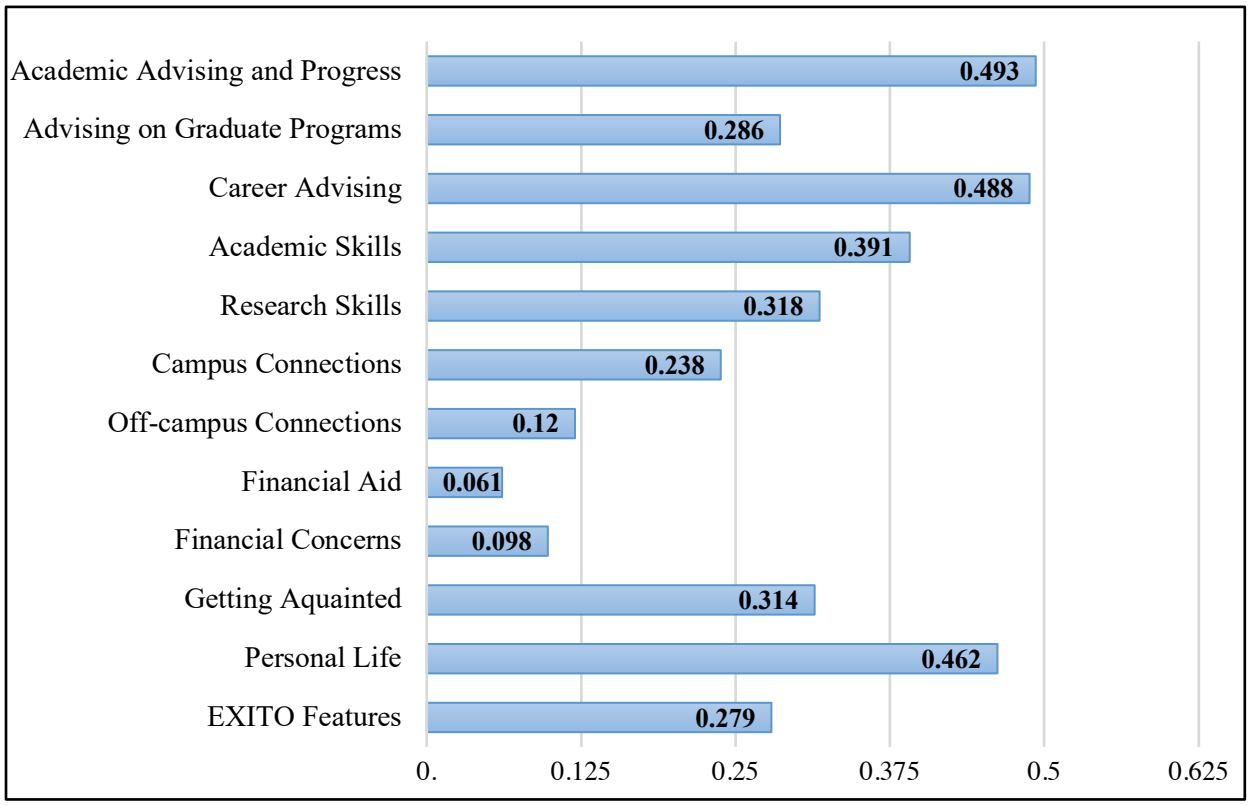
quency activities in the peer mentoring relationship, occurring on average over 30% of the reported months, involved attention to academic skills, getting acquainted, discussing features of the EXITO program, advising on academics and academic progress, and making campus connections to programs and services. The activity profile for career mentors, shown in Figure 2, depicts a somewhat different pattern. The two most common activities in the career mentoring relationship, reported for almost half of the scholar logs on average, were advising on academics/academic progress and career advising. Other high frequency activities with career mentors included addressing topics in scholars' personal lives, developing academic skills, developing research skills, and getting acquainted.

Figure 1. Mean proportion of mentoring logs reporting each activity for peer mentors (n=162)



Note: Proportion calculated for each student represents the number of logs reporting the given activity divided by the total number of logs submitted by the student for that mentor.

Figure 2. Mean proportion of mentoring logs reporting each activity for faculty career mentors (n=206)

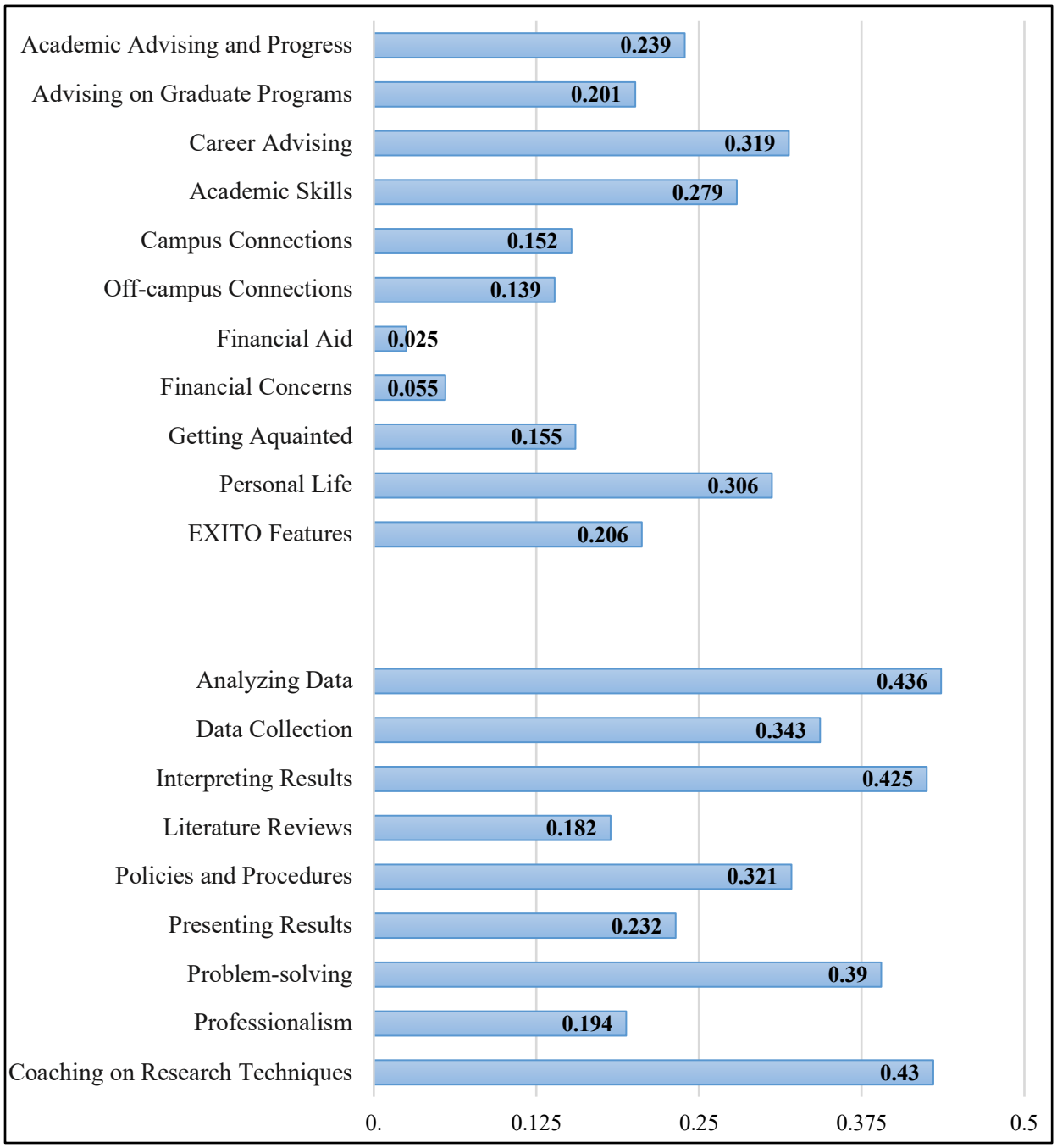


Note: Proportion calculated for each student represents the number of logs reporting the given activity divided by the total number of logs submitted by the student for that mentor.

The activity profile for research mentors was substantially different. As shown in Figure 3, only two of the general support activities, career advising and addressing personal life, were reported on over 30% of scholar logs pertaining to research mentors. However, seven of the eleven activities specific to research mentoring surpassed the 30% frequency threshold averaging across scholar logs. The high-frequency activities in which research mentors engaged scholars included reviewing theory, analyzing data, coaching on research techniques, interpreting results, problem-solving, instructing on policies and procedures. Across all three figures it can be seen that some topics, such as financial matters, are relatively less likely to be addressed in mentoring relationships, whereas other topics, such as discussing personal life, are more frequently reported.

For scholars who had logs reporting on each type of mentor, mean proportions for the frequency of each activity were compared by type of mentor with repeated-measures ANOVA with post hoc analyses of pairwise differences. As indicated in Table 2, statistically significant differences between mentor types were observed for all activities except making off-campus connections. Post hoc comparisons showed that career mentors were more likely than other mentors to engage in advising regarding academics, graduate programs, and careers.

Figure 3. Mean proportion of mentoring logs reporting each activity for research mentors (n=139)



Note: Proportion calculated for each student represents the number of logs reporting the given activity divided by the total number of logs submitted by the student for that mentor.

Peer mentors provided more academic advising than research mentors. On every other activity (excluding off-campus connections), peer mentors had the highest and research mentors had the lowest mean proportions, and post hoc analyses indicated these differences between peer and

research mentors were statistically significant. Career mentors also had higher mean proportions than research mentors on each activity with the exception of discussing EXITO program features. According to post hoc analyses, peer mentors were more likely than career mentors to engage in three activities—addressing skills needed for academic success, getting acquainted, and explaining EXITO program features.

Table 2. Repeated-measures ANOVA results comparing mean proportions by mentor type (N=97)

Activity	Peer Mentor	Career Mentor	Research Mentor	F	p	Post-hoc
	M (SD)	M (SD)	M (SD)			
Academic Advising and Progress	.427 (.386)	.545 (.304)	.212 (.247)	33.391	.000	C > P > R
Advising: Graduate Programs	.188 (.302)	.375 (.308)	.167 (.210)	20.063	.000	C > P/R
Career Advising or Planning	.225 (.318)	.503 (.316)	.296 (.282)	24.467	.000	C > P/R
Skills Needed for Academic Success	.544 (.380)	.408 (.298)	.274 (.281)	22.918	.000	P > C > R
Campus Connections	.380 (.368)	.283 (.278)	.165 (.214)	17.863	.000	P/C > R
Off-Campus Connections	.137 (.286)	.214 (.271)	.157 (.232)	2.787	.059	n/a
Financial Aid	.115 (.240)	.069 (.163)	.025 (.081)	7.966	.001	P/C > R
Financial Concerns	.161 (.298)	.103 (.176)	.055 (.118)	8.834	.001	P/C > R
Getting Acquainted	.406 (.369)	.296 (.290)	.157 (.244)	23.519	.000	P > C > R
Personal Life	.549 (.396)	.499 (.327)	.332 (.293)	14.907	.000	P/C > R
EXITO Program Features	.439 (.381)	.263 (.289)	.212 (.234)	20.570	.000	P > C/R

Note: df (2,192). Statistically significant findings below Bonferroni correction threshold of (p<.0045).

Although research mentors were least likely to participate in the general mentoring activities compared across three mentors, research mentors had notably high mean proportions across

several research-specific activities as reflected in the descriptive profile. Evaluating the relative frequency of research-specific activities to general mentoring activities, a paired-samples t-test comparing an average of the mean proportions across all research-specific activities (M=.337) to a comparable measure across all general mentoring activities (M=.189) was statistically significant (t=11.218, df=138, p<.001).

Discussion

The findings from this study suggest the three types of mentoring relationships established in the BUILD EXITO program differ in the nature and degree of support provided to scholars. Furthermore, the reported activities with each type of mentor generally align with the respective functions envisioned in the program's multiple mentor model. Faculty career mentors are the most likely to engage in advising on academics, career plans, and graduate program options. Peer mentors are the most likely to provide support by getting acquainted with scholars, helping them to develop skills needed for academic success, and supplying information about the EXITO program. Meanwhile, although they sometimes address topics like career advising or academic skills, research mentors are much more likely to spend their time with scholars engaging in a variety of activities directly related to learning research skills and conducting research.

The findings suggest that faculty career mentors help scholars chart a course through their undergraduate studies. Scholars may draw on the recognized knowledge and experience of faculty for advice regarding academic and career choices, or faculty may use these advising conversations as comfortable topics for guiding these relatively unstructured mentoring relationships. Conversations about academic plans and career goals are naturally intertwined as coursework may help to identify career directions or career goals may influence the choice of a major. Likewise, academic pathways and career ambitions shape decisions about graduate programs. Although advising on graduate programs was not reported as often as other forms of advising, the frequency of discussions about graduate school could shift as scholars move through the program and approach graduation. In fact, the mean proportion for graduate program advising was notably higher for the within-subjects sample, which likely is comprised of more advanced scholars by virtue of their also having a research mentor.

The data also indicate that career mentoring relationships involve more than advising. Career mentors also commonly engage in discussions related to developing research skills and skills needed for academic success. In addition, career mentors frequently spend time getting acquainted with scholars and discussing topics related to scholars' personal lives. Such activities are central to forming a strong mentoring relationship in which understanding the needs and interests of the scholar enables the mentor to provide relevant and individualized support and guidance (Schreiner et al., 2011). Furthermore, a potentially valuable function of career mentors is to provide advice about how to balance school, work, family, and other personal obligations (Kendricks et al., 2013). Similarly, a wide range of personal issues and challenges (e.g., self-confidence, discrimination, mental health, finances, housing) can affect academic progress and career choices.

Peer mentors also frequently engage in these same relationship-building activities, and to an even greater extent in the case of getting acquainted with scholars. Strong peer mentoring relationships are meant to provide camaraderie, to bolster a sense of belonging in the sciences, and to provide "insider" advice from the student perspective (Zaniewski & Reinholz, 2016). It is likely that conversations in peer mentoring relationships involve many exchanges of personal experiences and stories as peer mentors share their insights regarding academics, research, and student life (Hill & Reddy, 2007). Peer mentors were more likely than other mentors to support scholars in developing skills for academic success and learning about features of the EXITO program. These activities are consistent with the peer mentor role of sharing their strategies for overcoming academic challenges, navigating campus systems and structures, and getting the most out of a research training experience (Wallace et al., 2000). Selected as successful students with experience in research training programs, peer mentors could give suggestions regarding many practical matters such as choosing courses, organizing study groups, seeking tutoring, and identifying research opportunities. Similarly, peer mentors frequently advised scholars on academics and helped them make connections to campus opportunities, programs, and services.

In overseeing scholar placements in their RLCs, research mentors fulfill a distinct function in the EXITO program, and the findings indicate that their interactions with scholars differ from those of other mentors accordingly. On over a quarter of their logs, scholars reported that research mentors did engage in activities such advising on academics and careers, promoting academic skills, and discussing personal issues. However, research mentors were much more likely to participate in activities in line with their primary mentoring role—to train scholars in specific research skills and supervise them in making meaningful contributions to research projects. Although research mentors did not engage in personally-focused, conversation-based mentoring activities (e.g., getting acquainted) as often as other mentors, they were clearly involved in many project-focused, action-based activities with scholars (e.g., reviewing theory, analyzing data, interpreting results, problem-solving). It may be that research mentoring relationships are more likely to develop through doing (joint activity) than through talking (conversation). Scholars likely appreciate the tangible benefits of their work with their research mentors across multiple phases of the research process (Carpi et al., 2017; Fuchs et al., 2016). Regarding the few research-specific activities reported less frequently, it could be that they require less ongoing instruction (e.g., literature reviews) or are not yet required on the project (e.g., presenting results). In addition, some of these items are specifically addressed through other EXITO program components, such as enrichment workshops (e.g., professionalism) and summer seminars (e.g., understanding journal articles in journal club).

On a similar note, a few other mentoring activities are reported with low frequencies by scholars, such as conversations about financial aid, financial concerns, and making off-campus connections. It may be that scholars have a need to address these topics only occasionally or feel it is inappropriate or uncomfortable to discuss them with mentors. However, it also may be that

scholars turn to other EXITO program services for these issues. For example, EXITO has a designated financial aid consultant, and other program staff such as the academic advisor and program director are more directly involved in arranging EXITO financial packages and dealing with the financial aid office. Likewise, an important function of regular EXITO communications through the scholar newsletter and other outlets is to inform scholars of on and off campus events and opportunities.

Limitations

This study, as a secondary analysis of program data, has certain limitations worth noting. First, the actual items used in the EMSN logs to assess mentoring activities represent somewhat general categories and are subject to individual respondents' interpretations of their meanings. Second, not all respondents were consistent in submitting monthly logs, so these data sources reflect just a sampling of all mentoring activities over time. Relatedly, the proportion scores calculated for each respondent were devised to provide a common metric across individuals and to account for the non-independence of multiple logs completed by the same individuals. However, in the analysis, the proportion scores are given equal weight regardless of the number of logs an individual may have completed. Another issue concerns the timing of the logs relative to participant status in the EXITO program.

Because initiation of mentoring relationships corresponds to progression through the program, only the initial cohorts are represented with data on research mentoring activities, whereas all cohorts could have reported on career and peer mentoring. This point is important because implementation of the intervention shifted (hopefully improved) over time as systems and procedures were refined. Likewise, the nature of program participants changed as program visibility grew and recruitment strategies were enhanced over time. Finally, some program sites, particularly community colleges, struggled to implement peer mentoring given the challenges of identifying more advanced students to serve in that role, so some participants may have been systematically excluded from the within-subjects analysis.

Research Implications

Although the current study provides initial insights regarding the forms of support provided by different types of mentors in an undergraduate research training program, many intriguing questions for future research are relevant for program design and implementation. For example, it would be helpful to better understand processes in the growth and development of the mentoring relationships by investigating how the frequency of certain activities change with progress through the program over time. Some changes may occur as a result of a strengthening relationship leading to greater comfort in dealing with difficult topics (e.g., finances), whereas other changes may reflect the developmental priorities of the scholar (e.g., thinking of graduate school closer to graduation).

Another question is whether it is important for individual scholars to manage coverage across multiple activities regardless of which mentor is providing the support. Examining the pattern of

activities for individual scholars may reveal different strategies for balancing across multiple mentors or relying more heavily on one particularly strong mentoring relationship. Research also could focus on determining whether certain mentoring activities are associated with better scholar outcomes in terms of academic and career achievements. Such analyses also could investigate whether the effects of the mentoring activities are moderated by the interpersonal quality of the mentoring relationship.

Finally, future research may reveal other important mentoring activities not captured in the current analysis, particularly low frequency but critical supports that may represent turning points in the scholar's trajectory. Qualitative research, including analysis of the text responses in EMSN, may be especially helpful in addressing questions that call for greater depth and context.

Practice Implications

The findings of the current study do not necessarily imply that three types of mentoring relationships are essential for research training programs for undergraduates from traditionally underrepresented populations. Interventions should tailor mentoring approaches to the specific goals and circumstances of each training program. In some cases, a single mentor may be able to effectively engage in a variety of activities and provide multiple forms of support to a trainee. In other cases, a program may focus on only a clearly defined set of designated activities. However, the study findings do help to validate that mentoring relationships in the EXITO program are operating in a way that is consistent with the rationale for the multiple mentor model.

As a comprehensive, developmentally-sequenced, multi-year training program, EXITO emphasizes a holistic approach that attempts to address a wide range of factors that could affect scholar success in navigating from the first year of undergraduate education to enrollment in graduate school or employment in the biomedical workforce. Our findings clearly suggest the importance of EXITO scholars having mentors who can address topics related to academics and career development because research mentors focus primarily on the research activities associated with RLC projects. The distinct distribution of activities between research and other mentors makes sense because many RLCs are at the research-intensive partner institution, OHSU, and these research mentors may have very little connection to the undergraduate experience.

The critical question for the EXITO program is whether both career mentors and peer mentors add value. The preliminary response, based on the current findings, is that each type of mentor does provide a distinctive pattern of support. For six of eleven defined mentoring activities, statistically significant differences between career and peer mentors were observed in ways that matched the anticipated emphasis of their respective roles. Furthermore, even though there was considerable overlap between career and peer mentors engaging in the same activities, especially those without statistically significant differences, it seems reasonable to assume that the nature of the support provided may have differed substantially. In other words, career mentors and peer mentors may have approached a given topic in ways that reflected their unique perspectives and experiences, so what actually was discussed or advised in their conversations with

scholars could have been very different. Finally, another advantage to assigning a scholar both a career and a peer mentor is that if one mentoring relationship should prove less productive, due to availability or interpersonal dynamics, the other relationship offers another opportunity for the scholar to receive support.

Acknowledgments

Work reported in this publication was supported by the National Institutes of Health Common Fund and Office of Scientific Workforce Diversity under three linked awards RL5GM118963, TL4GM118965, and UL1GM118964, administered by the National Institute of General Medical Sciences. The work is solely the responsibility of the authors and does not necessarily represent the official view of the National Institutes of Health. Additional support was provided by the (list any industrial or other support). A special thanks to Kay Logan, Mentoring Program Coordinator, and Adrienne Zell, Evaluation Team Lead, and the students/trainees who participated in this NIH Diversity Program Consortium study.

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