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BUILDing Engaged Mentors: Examining the Efficacy of BUILD-led Mentor Training

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The practice of mentorship is a critical focus in science, technology, engineering, mathematics, and medicine (STEMM) disciplines. This quasi-experimental study investigated the efficacy of undergraduate mentor training in biomedical sciences programs in the NIH-funded Building Infrastructure Leading to Diversity (BUILD) initiative comprised of research-rising institutions. We used data from the Higher Education Research Institute's Faculty Survey (2016-17 and 2019-20). In cross-sectional comparisons of 379 BUILD-trained faculty with 755 colleagues who were not BUILD-trained, those who participated in BUILD mentor training reported more engagement with mentees. Utilizing propensity score matching of 314 with longitudinal cases, mentoring confidence and engagement were stronger over time for BUILD-trained faculty. Findings suggest BUILD mentor training yields positive results for undergraduate mentors at research-rising institutions.

Keywords: mentorship, STEMM, undergraduate mentoring, BUILD mentor training

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Introduction

Effective faculty mentorship of undergraduate students significantly enhances their success (Byars-Winston et al., 2015; Eagan et al., 2024). The National Academies of Sciences, Engineering, and Medicine ([NASEM], 2019) consensus report defines mentorship as a collaboration between individuals supporting "the personal and professional growth, development, and success of the relational partners through the provision of career and psychological support" (p. 2). Effective mentorship cultivates stronger feelings of belonging among mentees and enhances a sense of inclusion representing a critical component of retaining and increasing the numbers of historically underrepresented individuals in the sciences (Puritty et al., 2017). Puritty and colleagues (2017) have urged researchers and practitioners to increase not only the number of promising individuals from diverse backgrounds in science, technology, engineering, mathematics, and medicine (STEMM) but also the scope, depth, and quality of the experiences they have in STEMM spaces.

Improving the practice of faculty mentorship within STEMM disciplines has emerged as a critical focus of ongoing efforts to recruit and retain individuals, particularly those from underrepresented backgrounds, in research-related careers (NASEM, 2019; White-Lewis et al., 2022). Despite evidence that training and support of mentors can improve institutional climate (Trejo et al., 2022), many faculty members lack training on basic mentorship skills and competencies (Straus et al., 2013). However, "good mentoring can be learned" (Pfund et al., 2006, p. 473). Because faculty promotion and incentive structures typically reward faculty for their research productivity and teaching evaluations, faculty often spend less time and have fewer opportunities to engage in mentor training. Thus, institutional and departmental leaders have sought new strategies for making mentor training more accessible and salient for faculty (Spencer et al., 2018).

In response to these and other needs, the National Institutes of Health funded the Diversity Program Consortium, which includes the Building Infrastructure Leading to Diversity (BUILD) awards at 10 primary institutions "to implement and study innovative approaches to engage and retain students from diverse backgrounds in biomedical research" (National Institute of General Medical Sciences [NIGMS], 2022). To accelerate workforce development and build institutional capacity in research-rising institutions, NIGMS limited eligibility to institutions receiving less than $7.5 million in annual federal research project funding and having

25% or more of students receiving Pell Grants (Hurtado et al., 2017). Funded from 2014-2024, the BUILD initiative uniquely targeted student, faculty, and institutional development activities simultaneously. Each BUILD awardee focused on developing institutional research capacity and included efforts to better prepare faculty to work with students from diverse backgrounds. Faculty development activities varied across sites and often included a mix of training (pedagogical, research skills, and mentoring) and other infrastructure support designed to build capacity for research and mentoring and to achieve the Consortium's consensus outcomes.

Nine of the 10 BUILD programs facilitated faculty mentor training that contextually aligned with site-specific needs and interests, engaging almost 900 faculty participants. The various approaches encompassed in-person and/or online workshops, videos and group discussions, coaching, mentor resources, and mentoring communities. Awardees offered some trainings as single events and others as ongoing series. Some faculty participants received a formal recognition or certification to encourage sustained engagement in mentor training and fostering of inclusive research training environments. Topical areas included multicultural awareness, culturally responsive and inclusive mentoring, critical race theory, implicit bias, stereotype threat, microaggressions and microaffirmations, mentoring best practices, and faculty as change agents. Subsequent qualitative analyses of case studies data have shown increased understanding among faculty participants of student challenges and "perceived within themselves improved communication practices to better appreciate cultural differences between themselves and their mentees" (White-Lewis et al., 2022, p. 3).

Several BUILD sites also received training directly from the National Research Mentoring Network (NRMN), another component of the Diversity Program Consortium, either *Entering Mentoring* (Sorkness et al., 2017) or Culturally Aware Mentoring curricula and resources (Byars-Winston et al., 2018). Faculty participants in these professional development opportunities have self-reported significantly higher mentor competency scores (Pfund et al., 2014) and self-perceived mentoring skills (Day et al., 2023). When translated to research-rising schools with primarily undergraduate populations across public, private, and minority-serving institutions, sites adapted the training for their particular context.

The DPC Coordination and Evaluation Center (CEC) conducted the Enhance Diversity Study (EDS), a multi-site, national, longitudinal evaluation of BUILD program outcomes from annual faculty surveys linked with site programmatic records (Guerrero et al., 2022; McCreath et al., 2017). The CEC's quasi-experimental approach analyzed EDS data from two waves of the Higher Education Research Institute's (HERI) Faculty Survey (2016-17 and 2019-20) to investigate the efficacy of BUILD-led mentor training programs. Specifically, the evaluation team examined whether faculty who participated in BUILD-led mentor training reported more engagement with their mentees and higher ratings in their ability to serve as effective mentors compared to their non-BUILD colleagues at the same institutions who share similar demographic and professional characteristics.

This study addressed the following research questions:

> Do faculty who participate in BUILD-led mentor training report more engagement with their undergraduate student mentees (extent of engagement and frequency of communication) and higher self-ratings in their ability to serve as effective mentors compared to colleagues who did not participate in BUILD-led training?
>
> Does participation in BUILD-led mentor training contribute to changes in the frequency with which faculty report engaging with their student mentees and growth in their self-reported mentor self-efficacy?

Methods

Data Sources and Measures

In this study, we analyzed data from the 2016-17 and 2019-20 administrations of the HERI Faculty Survey. The survey collects information on faculty professional activities and attitudes. We used items covering respondents' demographics, professional characteristics (e.g., rank, departmental affiliation, tenure status), and professional development activities related to mentorship. Guided by the Diversity Program Consortium's Hallmarks of Success related to faculty mentoring (McCreath et al., 2017), we analyzed the following outcomes:

1. Mentoring undergraduates: "Indicate the extent to which you mentor undergraduates," a five-point Likert response ranging from "Not at All" to "A Very Large Extent;"

2. Communication with undergraduate mentees: "How often do you typically communicate with undergraduate mentees?," a five-point Likert response ranging from "Yearly" to "Daily;" and,

3. Mentor self-efficacy: a latent measure composed of six items related to faculty confidence in their ability to effectively mentor students. HERI used Item Response Theory techniques (Sharkness et al., 2010) to confirm the latent properties of this measure (HERI, 2017) and then standardized and rescaled the variable to have a mean of 50 and a standard deviation of 10.

We created a binary indicator of participation in

BUILD-led mentor training based on programmatic records supplied by BUILD sites (Maccalla et al., 2022). For respondents completing the survey in Spring 2017, we defined participation for a given faculty member as involvement in a BUILD-led mentor training by December 2016. Similarly, for those responding to the Spring 2020 survey, we defined participation as involvement by December 2019. For our second research question, which looked at growth over time, faculty in the training treatment group had to have participated in their first BUILD-led mentor training by December 2019.

BUILD awardees implemented novel approaches to faculty mentor training. Several institutions used initial sessions and periodic follow-ups, asynchronous videos, online forums, discussion groups, and incentives and certifications (Collins et al., 2017; Foroozesh et al., 2017; Kamangar et al., 2017; Saetermoe et al., 2017; Urizar et al., 2017; Young et al., 2021). Some implemented tiered mentoring strategies by including experienced staff personnel or peer mentors with faculty in the mentor training (Andreoli et al., 2017; Gildehaus et al., 2019; Keller et al., 2017; Richardson et al., 2017; Taylor et al., 2017). Sites also launched broad initiatives to impact campus culture and train faculty across disciplines (Foroozesh et al., 2017; Saetermoe et al., 2017; Young et al., 2021). Theory-driven initiatives trained faculty to better understand student experiences and listen to perspectives from members of groups historically and still underrepresented in STEMM (Estrada et al., 2017; Saetermoe et al., 2017). Many awardees leveraged centralized training and resources within existing or new offices (Foroozesh et al., 2017; Urizar et al., 2017) or relied on robust institutional structures (LaCourse et al., 2017). Seven BUILD programs reported using resources developed by, adapting training from, or participating in mentor training workshops developed by NRMN.

Sampling

We invited faculty with departmental affiliations in medicine, life sciences, engineering, physical sciences, and social sciences to participate in EDS surveys, as these fields constitute the focus of the BUILD programming and evaluation. We sampled all faculty members appearing on a BUILD program activity roster, and we also sent invitations to faculty from these disciplines who had no affiliation with BUILD program activities to form the comparison group (Guerrero et al., 2022). The initial sample was created with the 2017 survey; of 2,496 invited, 26% responded (consistent with HERI national response rates). This group became the baseline sample. We enrolled new faculty in the EDS in subsequent years as they participated in BUILD activities. In 2020, we refreshed the comparison group to ensure we included newly hired faculty and accounted for retirements and opt outs. Of the 2,048 invited, 40% responded. We attribute the higher response rate to the fact that, for many faculty, the 2020 HERI Faculty Survey represented the fourth faculty-focused EDS survey, so more faculty saw the requests for their participation as credible and valid.

Study Participants

For this analysis, we included all faculty who completed the survey at either time point. Of the 1,134 faculty who completed either survey, 379 (33%) completed BUILD-led mentor training. Of the 379 BUILD-trained faculty, 64% first participated in mentor training prior to 2017, and 37% were trained between 2017 and 2019. Our sample for the analyses addressing the second research question included 314 faculty who completed both waves of the HERI Faculty Survey, of whom 110 (35%) had participated in BUILD-led mentor training by December 2019.

BUILD mentor-trained and comparison faculty shared many similarities in their demographic and professional characteristics (Table 1). The BUILD-trained faculty were more likely to be women than men compared to those not BUILD-trained. Both groups had similar racial and ethnic compositions, with the largest percentage of faculty identifying as White or Asian. African American faculty participated in BUILD training at higher rates than other groups. Faculty represented a wide range of departments, with disciplines divided into those that typically participate in biomedical research and those that do not. We further divided biomedical disciplines into natural sciences and social sciences, with non-biomedical fields grouped together. BUILD-trained faculty were more likely to be early career faculty (36% assistant professor, 33% associate professor) than the comparison sample (29% assistant professor, 22% associate professor). The majority of faculty reported that their principal activity at their institution was teaching or research. We then conducted mixed regression analyses with repeated measures (including a random effect for participants and a fixed effect for survey year, PROC MIXED, SAS Institute, Version 9.4) for mentor self-efficacy and ordinal logistic regression models with cumulative logit functions for the other two mentor engagement outcomes (PROC GEE, SAS Institute, Version 9.4).

To answer our second research question, we applied a quasi-experimental design to address the observational nature of our data and to leverage a counterfactual approach (Rosenbaum & Rubin, 1983). We reorganized our data in a wide format for the 314 faculty who participated in both waves of the HERI Faculty Survey. We first conducted a fixed-effects logistic regression predicting the probability of having participated in BUILD-led mentor training by December 2019. Key covariates included demographic and professional characteristics and baseline measures from the 2016-17 survey on mentor self-efficacy, frequency of communicating with mentees, and the extent to which faculty mentored undergraduates. This approach aimed to account for the fact that BUILD-

Table 1.
Percentage Distribution of EDS HERI Faculty Survey Respondent Demographics by BUILD Training Status

Participant characteristic	Percentage	
	BUILD-trained (n = 379)	Not BUILD-trained (n = 755)
Gender**		
Man	38	47
Woman	61	52
Non-Binary	1	1
Race/ethnicity		
African American and/or Black*	14	10
American Indian and/or Alaska Native	3	2
Asian	19	18
Latine	10	11
Middle Eastern and/or North African	2	2
Native Hawaiian and/ or Pacific Islander	0	1
White	56	62
Other	2	3
Not Specified	3	2
Faculty department		
Not Biomedical	28	26
Biomedical Social Sciences	16	16
Biomedical Natural Sciences	56	57
Faculty rank***		
Lecturer/Instructor	5	17
Assistant Professor	36	29
Associate Professor	33	22
Professor	25	31
Faculty principal activity*	(n = 375)	(n = 729)
Administration	8	7
Teaching	72	64
Research	19	27
Other	2	3
Self-reported extent of mentor training***	(n = 371)	(n = 718)
Not at all/Small extent	25	57
Some/Large/Very large extent	75	43
Self-reported extent of access to NRMN resources***	(n = 372)	(n = 718)
Not at all/Small extent	60	87
Some/Large/Very large extent	40	13

Note. Faculty self-identified with as many race ethnicity categories as appropriate so percentage distributions total over 100%. Faculty who identified as women or non-binary were grouped for further analyses. Abbreviations: EDS - Enhance Diversity Study; HERI - Higher Education Research Institute; NRMN - National Research Mentoring Network; BUILD –Building Infrastructure Leading to Diversity programs.
* p <0.05, ** p < 0.01, *** p < 0.001 for differences between BUILD-trained faculty and faculty that did not participate in BUILD training (Chi-square)

Table 2.
Distribution of Mentor Training Outcomes by BUILD-Trained Status

	BUILD-trained	Not BUILD-trained
Outcome measure	**M (SD)**	
Mentor self-efficacy (N = 1,435)*	(n = 429) 52.25 (7.98)	(n = 1006) 50.87 (9.00)
	Percentage	
Extent mentor undergraduates (N=1,385)* **	**(n = 422)**	**(n = 963)**
Not at all	4	8
To a small extent	4	10
To some extent	14	21
To a large extent	25	27
To a very large extent	53	33
Frequency communicate with undergraduate mentees (N=1,075)**	**(n = 369)**	**(n = 706)**
Yearly	0	0
Once per term	3	8
Monthly	13	20
Weekly	72	61
Daily	12	11

Note. n refers to person-year observations, so some individual faculty members are represented twice in these data. Abbreviations: BUILD – NIH Building Infrastructure Leading to Diversity programs.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for differences between groups, controlling for BUILD program and survey year

led mentor training may attract certain types of faculty (e.g., those predisposed to participating in professional development activities or those more concerned about mentorship), and we believe any causal inferences we make about the effect of BUILD-led mentor training on our outcomes carry greater credibility (Desjardins et al., 2002) than they would had we not used this approach.

The logistic regression predicting participation in BUILD-led mentor training generated a set of propensity scores, which indicate the probability that each faculty member would participate in the training. We trimmed the sample to exclude a total of 12 cases from both the treatment or control groups where we lacked sufficient overlap in propensity scores (Guo & Fraser, 2010). Next, we calculated inverse probability weights representing the average treatment effect (ATE) for all respondents in the final analytic sample (Eagan et al., 2013). Finally, we applied these inverse probability weights in a series of regression models predicting each of our three outcomes. These weighted regression models included the same set of covariates described and reported in our models addressing our first research question.

Limitations

We acknowledge several key limitations of our study analyses. First, we were limited by the items and definitions on the survey. Although using HERI Faculty Survey data enabled collection of reliable and validated measures, the items on the survey were not developed explicitly for the purposes of this study. Second, our treatment indicator of mentor training reflects a binary operationalization. In the next section, we report the results of sensitivity tests for the intensity of faculty exposure to BUILD-led mentor training, but our analyses cannot account for the consistency or frequency of faculty participation in the various BUILD-sponsored mentor training opportunities. Third, BUILD site interventions were similar but not identical. Finally, our relatively small sample of faculty informing analyses for the second research question might have constrained our ability to detect statistically significant relationships; however, we think that examining longitudinal faculty development across our study's three outcomes provides important insights into the ways in which faculty can learn and grow in their mentoring capacity over time.

Results

BUILD-trained faculty engaged significantly more with undergraduate mentees than faculty who did not participate in BUILD training (Table 2). They rated their mentor self-efficacy higher, mentored undergraduates to a greater extent, and communicated more frequently with their mentees.

Table 3
Results of Regression Models Predicting Mentor Self-Efficacy

	Mentor self-efficacy			
	Model 1 (N = 1,433)		Model 2 (N = 1,373)	
Independent variables	**Coeff.**	**SE**	**Coeff.**	**SE**
BUILD trained	1.13	0.57*	-0.12	0.59
Gender (Ref: Man)	1.45	0.52**	1.48	0.51**
Academic rank (Ref: Professor)				
Associate Professor	-1.23	0.64	-1.43	0.63*
Assistant Professor	-0.45	0.64	-1.03	0.63
Lecturer/Instructor	-1.47	0.89	-1.96	0.87*
Principal activity: Teaching (Ref: Not Teaching)	-0.70	0.70	0.14	0.77
Principal activity: Research (Ref: Not Research)	1.35	0.84	1.89	0.88*
Department Type (Ref: Not Biomedical)				
Natural Sciences	-1.34	0.61*	-1.24	0.60*
Social Sciences	-0.08	0.80	0.11	0.78
Extent participated in mentor training	--	--	3.42	0.49***
Extent accessed NRMN resources	--	--	1.39	0.59*

Note. Model 1 includes demographics, professional characteristics, BUILD site, and survey year. Model 2 adds self-reported participation in mentoring professional development activities, grouping the responses Some to Very Large Extent. Abbreviations: BUILD – NIH Building Infrastructure Leading to Diversity programs; NRMN - National Research Mentoring Network, Coeff. - Coefficient.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

These differences persisted when controlling for professional and demographic characteristics (Table 3, Model 1). For mentor self-efficacy, women and non-binary faculty rated themselves higher than men after accounting for BUILD training and other factors. Faculty in natural science departments rated themselves lower than those in social sciences or non-biomedical departments. After accounting for the extent of mentor training participation as reported by faculty on the survey and accessing of NRMN resources, BUILD-trained faculty did not significantly differ in their mentor self-efficacy from faculty who did not participate in BUILD-led mentor training (Table 3, Model 2).

BUILD-trained faculty mentored undergraduates to a greater extent, regardless of other factors examined (Table 4). In addition, those whose principal activity was teaching, or those who research mentored more extensively (not surprising, as administrators mentor students less than other faculty), as did those in biomedical-related disciplines. BUILD-trained faculty also communicated more frequently with their mentees after accounting for professional and demographic characteristics, but we found this association to be fully attenuated after including the self-reported extent of mentor training and accessing of NRMN resources in the model (Table 4), suggesting that any form of mentor training can increase how often faculty communicate with undergraduate mentees.

To better account for the variety of BUILD training, we modified the models to compare those with no BUILD training to those who participated in BUILD training that lasted at least eight hours and those who participated in BUILD training for shorter periods (data not shown). We detected no differences between groups for mentor self-efficacy and both BUILD trained groups engaged with undergraduate mentees to a greater extent than those not trained. Those with longer BUILD training communicated more frequently with mentees than those with none or shorter BUILD training.

Table 5 presents the results from the weighted regression models addressing the second research question. We adjusted the sample using the ATE inverse probability weights to account for the non-random assignment of faculty into the treatment (BUILD-led mentor training participation) and control (no participation in BUILD-led mentor training) conditions. Model 1 for each outcome shows the effect of participating in BUILD-led training controlling for BUILD site, demographic

Table 4.
Results of Regression Models Predicting Mentor Engagement Outcomes

	Extent mentor undergraduates				Frequency communicate with undergraduate mentees			
	Model 1 (n = 1,384)		Model 2 (n = 1,368)		Model 3 (n = 1,074)		Model 4 (n = 1,043)	
Independent variables	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
BUILD trained	0.69	0.13***	0.48	0.14**	0.46	0.17**	0.30	0.18
Gender (Ref: Man)	-0.03	0.11	-0.04	0.11	-0.20	0.15	-0.24	0.15
Academic rank (Ref: Professor)								
Associate Professor	-0.12	0.13	-0.14	0.13	-0.13	0.19	-0.12	0.19
Assistant Professor	0.05	0.14	-0.03	0.14	0.21	0.18	0.21	0.18
Lecturer/ Instructor	-0.09	0.27	-0.13	0.19	-0.41	0.25	-0.39	0.25
Principal activity: Teaching (Ref: Not Teaching)	0.36	0.16*	0.46	0.16**	0.32	0.22	0.41	0.24
Principal activity: Research (Ref: Not Research)	0.36	0.19*	0.42	0.19*	0.85	0.26**	0.94	0.27**
Department Type (Ref: Not Biomedical)								
Natural Sciences	0.42	0.14**	0.35	0.14*	0.74	0.18***	0.64	0.18**
Social Sciences	0.53	0.17**	0.50	0.18**	0.51	0.21*	0.41	0.22
Extent participated in mentor training	--	--	0.45	0.11***	--	--	0.23	0.15
Extent accessed NRMN resources	--	--	0.52	0.14**	--	--	0.41	0.17*

Note. Model 1 includes demographics, professional characteristics, BUILD site, and survey year. Model 2 adds self-reported participation in mentoring professional development activities, grouping the responses Some to Very Large Extent. Abbreviations: BUILD – NIH Building Infrastructure Leading to Diversity programs; NRMN - National Research Mentoring Network, Coeff. - Coefficient.
* p,0.05, ** p ,0.01, *** p<0.00

characteristics, professional characteristics, and the corresponding pre-test measure from the 2017 survey administration for each respective outcome. Model 2 shows the results for participation in BUILD-led training after accounting for all covariates from Model 1, as well as indicators for the extent of faculty participation in other mentor trainings offered by their institution and the extent to which they accessed resources from NRMN.

Faculty who participated in BUILD-led mentor training reported significantly stronger mentor self-efficacy after controlling for their 2017 mentor self-efficacy, their demographics, and relevant professional characteristics (Model 1). In Model 2, we found that controlling for participation in other mentor trainings at the institution and accessing NRMN resources fully attenuated the effect of BUILD-led mentor training on faculty mentoring self-efficacy. In other words, faculty who participated in BUILD-led mentor training were also more likely to access resources provided by NRMN, which explained away the strength of the association between BUILD-led mentor training and mentor self-efficacy. Accessing NRMN resources significantly boosted faculty mentor self-efficacy by spring 2020.

Faculty participants in BUILD-led mentor training mentored undergraduates to a significantly greater extent than their demographically and professionally similar colleagues. This relationship held across our nested models, meaning that participation in BUILD-led mentor training significantly enhanced the extent to which faculty members mentored undergraduates even after controlling for their demographics, professional characteristics, pre-test, and participation in other forms of professional development connected to mentoring.

The analyses of faculty frequency of communicating with undergraduates did not yield any significant effects for participation in BUILD-led mentor training in either model. Faculty participants in BUILD-led mentor training did not significantly differ in how often they communicated with their undergraduate mentees from those not participating in BUILD-

Table 5.
Selected Results of Longitudinal Regression Models Predicting Three Mento Training Outcomes

	Mentor Self-Efficacy			
	Model 1		Model 2	
Independent variables	Coeff.	SE	Coeff.	SE
BUILD trained	1.23	0.62*	0.97	0.64
Extent participated in mentor training			0.13	0.29
Extent accessed NRMN resources			0.89	0.32**
	Extent of Mentoring Undergraduates			
BUILD trained	0.38	0.10***	0.36	0.10***
Extent participated in mentor training			-0.11	0.12
Extent accessed NRMN resources			0.23	0.12
	Communicating with Undergraduate Mentees			
BUILD trained	0.08	0.06	0.11	0.06
Extent participated in mentor training			0.01	0.03
Extent accessed NRMN resources			-0.23	0.08**

Note: Data weighted using the average treatment effect weight. Model 1 includes demographics, professional characteristics, BUILD site, and pre-test score. Model 2 adds self-reported participation in mentoring professional development activities, grouping the responses Some to Very Large Extent. Abbreviations: BUILD – NIH Building Infrastructure Leading to Diversity programs; NRMN - National Research Mentoring Network, Coeff. - Coefficient.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

led professional development. We attribute the modest, negative association regarding accessing NRMN resources and faculty communication with undergraduate mentees to multicollinearity in the dataset, as these two measures had a positive, simple correlation.

Discussion

Findings from this study provide insights into faculty mentoring perceptions and practices from sustained, programmatic attention to mentoring excellence at institutions focused on undergraduate teaching in biomedical sciences. BUILD-trained faculty engaged more with their undergraduate mentees and communicated with them more frequently. Additionally, BUILD-trained mentors gained significantly more confidence in their mentoring ability compared to their colleagues not trained by BUILD. Notably, BUILD mentor training occurred within structured programs and often extended training beyond faculty to staff and other students to serve as peer or near-peer mentors.

Our findings concerning the extent of participation in mentor training and access of NRMN resources demonstrate the generalized value of mentor training. These results suggest that campuses may not need to create training on their own and instead can deploy accessible, expert-developed professional development sessions for their faculty. In many cases, BUILD awardees adapted some of the training components developed by NRMN, and these novel approaches likely elevated the importance of local context to train faculty in flexible ways. Campuses may also consider incentivizing faculty participation in mentor training (leveraging institutional influencers and existing structures or administrative offices, offering stipends or certificates of completion, and mandating training for eligibility for mentee lab placement). Meeting institutional needs may bolster buy-in to create inclusive research environments and minimize pressure on individual faculty (White-Lewis et al., 2022). Our findings also emphasize the importance of institutionalized rather than program-based support to sustain faculty mentoring activities.

Because our study lacked a true baseline of faculty mentorship prior to training, our findings likely hew a bit more conservative, as BUILD clearly attracted faculty already predisposed to mentorship and inclined to participate in mentor training. Also, our surveys were not directly integrated into the mentor training at BUILD programs, so we had survey information from only a subset of training participants. Nonetheless, our survey respondents represented multiple institutions and BUILD programs, ranged across the professoriate, and included numbers of faculty

from groups traditionally underrepresented in academic positions. Thus, these findings contribute to emerging evidence of the value of addressing mentoring as a professional skillset important for those working with diverse students in institutions of higher education.

While our findings document the efficacy of the approaches BUILD sites employed to train faculty mentors, future quantitatively focused studies could add nuance and depth to this conversation. For example, future studies may more specifically examine how the intensity, frequency, or regularity of mentor training can improve outcomes for faculty. Future work may also consider using larger, multi-institutional datasets to examine whether and how faculty develop in their competencies and skills based on their participation in various forms of mentor training.

Our results suggest that institutions and biomedical science departments would be wise to invest in their faculty by providing opportunities to engage in professional development related to mentoring. At the very least, leveraging existing, readily available resources and tools like those offered by NRMN would seem to significantly boost faculty confidence in their mentoring abilities and enhance the extent to which they engage with their undergraduate mentees. Improving faculty mentoring confidence, communication, and engagement with undergraduate mentees may help to advance efforts to develop and sustain a culture of inclusion.

This research adds to the growing evidence of the value of mentor training for faculty in STEMM fields, especially for scalable training programs. This work underscores the importance of delineating how mentors are trained and what resources are used. Such planning can contribute to the broader goal of ensuring STEMM education is more inclusive and, ultimately, more successful for all those involved.

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