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Mentoring Networks in Academic Medicine: A Longitudinal Exploration

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The importance of ethnic and gender representation in academic medicine is of paramount importance. While mentoring effectively attracts and retains underrepresented individuals, scientists from underrepresented groups face barriers to high-quality mentorship. The developmental network model by Higgins and Kram suggests that a variety of people with unique knowledge, connections, and resources can help propel an individual's career and personal growth. This study experimentally tested the outcomes of a workshop series and mentorship program to assist early-career biomedical investigators from predominantly minority institutions establish and maintain developmental networks. This study provides preliminary insights into the characteristics of these developmental networks for investigators with different funding goals and how these networks evolve, potentially impacting career trajectories.

Keywords: developmental networks, mentoring, underrepresented minorities, academic medicine, early-career

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Introduction

According to the National Academies of Science, Engineering, and Medicine Committee on Effective Mentoring in STEMM (2019), mentorship is a professional relationship that fosters personal and professional growth and success by providing career and psychosocial support. Research conducted by Palepu and colleagues (1998), Sambunjak and colleagues (2006), and Illes and colleagues (2000) have shown that mentorship has a positive impact on career development and research productivity, including scholarship and grant success. Despite the apparent benefits of faculty mentoring, access to and the quality of mentorship networks can vary tremendously for early-career professionals, in part due to variation in the extent to which institutions provide formalized opportunities for early-career scholars to form mentoring relationships. An absence of or ineffective mentorship can lead to negative career consequences such as limited access to resources, guidance, and opportunities.

Developmental Networks

Over the past decade, mentorship models have evolved from being largely dyadic and hierarchical, consisting of a single subordinate mentee and a superior mentor, to more contemporary versions involving numerous mentors with varying levels of experience who are adept at meeting the pluralistic needs of an individual. The Developmental Network Model (Higgins & Kram, 2001) suggests that a variety of mentors - each with unique skills, knowledge, and shared perspectives - can take an active interest in an individual's career and personal growth; and provide psychosocial support, support for completing work, and career advancement. Developmental mentors in academic medicine include research advisors, statisticians, academic investigators, physicians, clinical trial experts, and others who provide access to knowledge, opportunities, and resources. Receiving career assistance from developers increases individuals' access to information, resources, and various career possibilities (cf., Burt, 1992).

Drawing on social network theories (Burt, 1992; Granovetter, 1973), and based on over two decades of dyadic mentorship relationships, Higgins and Kram (2001) devised a model of developmental networks that takes into account two key aspects: the strength of the developmental tie and the diversity of the network, which encompasses the range (number of social systems from which relationships arise) and density (the level of interconnectedness between developers). This model of networks helps evaluate the developmental connections of focal individuals and highlights how individuals within their networks can optimize their professional and personal growth.

Individuals with strong ties to a mentor benefit from increased motivation on the mentor's part to act on their behalf (Granovetter, 1982; Krackhardt, 1992). Strong ties are characterized by respect, trust, and care. A dense network,

which is often marked by numerous connections between developers, is advantageous for individuals seeking to advance within a prescribed context where coordination among developers is critical. However, a dense network can reinforce shared knowledge and impede the exploration of alternatives. In contrast, a sparse network, characterized by a lack of connections between developers who likely come from different social spheres, can be beneficial for individuals seeking to change courses or bridge disciplines, both within and outside an organizational or professional context. Such a network exposes individuals to new information and diverse viewpoints.

In the present study, we evaluated the effectiveness of a professional development program delivered over a 12-month period for early-career investigators (see Weber-Main et al., 2020). We empowered participants to assess and fortify their developmental networks through a series of five workshops and guidance from a developer. By comparing the outcomes for participants in this professional development program to those of a control group that did not receive such guidance, we can evaluate the effectiveness of the initiative. This report presents preliminary findings on the impact of this program.

Mentoring Underrepresented Minorities

Developing community-driven and culturally relevant solutions to address health inequities poses challenges, including providing adequate institutional support for junior faculty and early-career researchers investigating such solutions and fostering collaboration across institutions. In addition to these challenges, investigators at predominantly-minority institutions often encounter obstacles that can impede their career advancement, such as limited start-up funds, leadership turnover, inadequate support for grant development, and substantial teaching and service responsibilities (Yanagihara et al., 2021). Similarly, the infrastructure and culture of non-predominantly-minority institutions may lack the necessary structural and social elements to ensure that racial and ethnic minorities, women, and individuals with disabilities enjoy equitable inclusion in scientific endeavors (Ofili et al., 2021).

Mentoring and training are effective ways to prepare new and early-career investigators with effective research skills. However, research suggests that scientists from underrepresented groups are only sometimes included equally in mentoring relationships, and typically require greater access to high-quality mentorship. This is evidenced by a recent comprehensive literature review conducted by Randsdell and colleagues (2021), who examined 46 published papers and found that individuals from underrepresented groups face obstacles in research development such as prejudice, discrimination, isolation, devaluation of expertise, and a dearth of mentors.

Insufficient social connections can contribute to a lack of career advancement for ethnic minority individuals and women in the workplace (Ibarra, 1995). As members of underrepresented groups often lack access to informal peer networks within their organizations, developmental networks can be crucial for professional identity development and career advancement (Ibarra, 1999). Developmental networks offer access to sponsors - typically those with a high status - who can connect them to job opportunities, advocate for their skills, and increase their visibility within the organization (Hewlett, 2013). Furthermore, high levels of developmental support have been shown to positively impact an individual's long-term commitment to their employer, as well as their intention to stay with an organization (Higgins &Thomas, 2001).

In 1985, Congress established the Research Centers in Minority Institutions (RCMIs) program, which has played a vital role in increasing the contribution of scholars from underrepresented groups in biomedical and health disparity research (Ofili et al, 2021). RCMIs aim to improve research training, conduct, and infrastructure at minority-serving colleges and universities, with the goal of cultivating early-career investigators from groups typically underrepresented in biomedical research. Presently, 22 RCMIs are working to enhance their capacity in basic biomedical, behavioral, and clinical research, provide training and support to affiliated investigators to obtain extramural funding, particularly from the National Institutes of Health (NIH), develop new and early-career investigators, and improve the quality of research on minority health and health disparities (Olfi et al.).

Acknowledging the absence of significant social and instrumental support in the workplace for underrepresented minorities (Ibarra, 1993), as well as the lack of sufficient research on the types of networks that would be most beneficial to underrepresented minority scholars in academic medicine, the present study progresses the RCMI program's agenda by examining the outcomes of a workshop series and mentorship program aimed at bolstering the developmental networks of underrepresented biomedical post-docs and junior faculty.

Fostering Strong Developmental Relationships

The degree to which a focal individual successfully procures developmental support from developers depends in part on whether the individual adopts a proactive or passive posture in initiating and fostering such connections (Higgins & Kram, 2001). To effectively utilize knowledge about different types of developers and their worth, the focal individual must possess the interpersonal skills necessary to initiate, maintain, and transform ongoing relationships (Schein 2010, 2013). Establishing a mentor-mentee relationship requires self-assessment, engaging in shared

reflection, demonstrating empathy, revealing personal information, and practicing self-management (Pearce, 2007).

In contrast, a passive attitude is fostered by factors such as insecurity and apprehension about approaching a potential developer. A lack of knowledge about how to approach a developer for assistance, or how to structure interactions, can impede a focal individual from being proactive in building relationships. Someone who is passively engaged in a developmental relationship may receive help only when it is offered; or may seek help from others but then refrain from reciprocating, continuing to initiate engagement, or expressing themselves fully in the relationship to grow bonds. If a focal individual does not actively seek help from and cultivate developmental relationships, their multiple ties are likely to be weak (Higgins & Kram, 2001). The result could be that passively engaged individuals receive less developmental support than individuals who are more proactively engaged with their developmental network (Higgins & Kram).

Network Diversity

The advantage of a wide-ranging network derives from its ability to bridge otherwise unconnected clusters of people. Developmental networks encompassing various types of diversity, such as role and cultural diversity, enhance the potential for novel ideas and perspectives to improve the focal individual's knowledge, understanding, skills, and readiness for prospects. A diverse developmental network encompassing multiple social systems enhances the focal individual's exposure to varied ideas and approaches, ultimately enriching their research. In contrast, mentors drawn from the same field or social context are likely to be highly similar, or even redundant, in the expertise and support they can provide the protégé (Burt, 1992; Burt & Minor, 1983; Granovetter, 1973; Higgins & Kram, 2001). When their developmental networks are limited in scope, focal individuals may need access to stimulating ideas or other growth-promoting actions that can help advance their careers.

Early-Career Mentoring

Finding supportive developmental networks is particularly important during certain career stages. One of these career stages occurs during initial onboarding or socialization, when individuals experience great uncertainty as they transition to their new career (Van Maanen & Shein, 1979). Supportive ties can help individuals learn from others in a new job (Morrison, 2002), easing adjustment. Further, developers in a network can assist early-career investigators by providing access to resources such as field sites, equipment, facilities, or samples for testing.

Developers also are instrumental in providing feedback on research proposals. Receiving a research grant has been shown to lead to increased research output and faster career advancement (Graddy-Reed, Lanahan, & D'Agostino , 2021; Heyard & Hottenrot, 2021; van den Besselaar & Sandström, 2015) even after accounting for early productivity differences. Thus, early-career researchers seeking to establish independence commonly apply for research grants such as the RO1 award to fund high-impact projects. R-type grants are awarded for short-term projects and tend to focus on basic research. In contrast, K-type awards are intended to support a longer stream of research, often clinical or translational in nature, that would enable an investigator to achieve independence. Developers can play an essential role in enhancing the quality of each type of research proposal by helping the focal individual formulate a novel, clinically important question.

Building on existing research on the role of mentor relationships formed in an academic setting, the present study examined the impact of the developmental relationships formed during graduate and postgraduate school on the career progression of translational biomedical scholars.

Method

Participants

Participants in this study were members of the National Research Mentoring Network, which accepts a new cohort of early-career investigators each year. The present study focused on Cohorts 1 and 2, which began in December 2019 and 2020, respectively. The participants were all early-career investigators specializing in Health Equity research.

Data collection occurred over three years at two different time points for each participant. Sixty-five participants answered the survey either completely or nearly completely at Time 1, and thirty-six participants answered the survey either completely or nearly completely at Time 2. In total, 29 individuals fully or nearly fully responded at both times. Mean values for the demographic characteristics of participants at each Time are summarized in Tables 1 and 2 (see Appendix).

Materials

All data were collected through online surveys administered via the Qualtrics online survey platform. Each survey asked for basic demographic and professional information including sex, ethnicity, field of study, career stage, and faculty rank.

Developmental networks can be assessed both qualitatively and quantitatively using a network elicitation approach (Cummings & Higgins, 2006). This approach entails a three-step procedure, including name generation, name interpretation, and network structure. Specifically, in each online survey we asked participants to identify the members of their developmental network with this prompt: "Think about the people who currently (in

the past year) have expressed an active interest in and acted to advance your career by assisting you with your personal and professional development. Think broadly. These may be people from your work or outside of work (e.g. mentors, coaches, family members, peers, professional contacts, friends, etc.)." Typically, this prompt generates four or five names for "developers" that the protege considers as providing meaningful developmental support (Higgins & Kram, 2001).

To better understand the characteristics of each developer and the nature of their developmental relationship with the participant, we asked participants about the type and amount of help each developer provided, the age of the relationship, and several demographic traits of each developer.

Finally, structural properties of a focal individual's developmental network can be assessed by drawing on the entirety of the individual mentorship relationships. This was done by asking participants to fill out a network matrix, a common method in social network research (Burt, 1992). This social network matrix allows for the analysis of the network structure and the patterns of relationships between developers, including the variables of tie strength, density—the number of social systems represented within a network—and degree centralization—the number of ties an individual has within a social network. A network matrix complements dyadic data, lending the power to reveal if interactions between developers produce augmented support for the focal individual. For instance, developers who know each other are more likely to collectively discuss the progress of a focal individual or strategize how to make resources or opportunities available to them, making the support of the developmental network, as a whole, more significant than the sum of its parts.

Procedure

Participants from Cohorts 1 and 2 of the National Research Mentoring Network were randomly assigned to the control or experimental group. We collected basic demographic and professional information. All participants received grant development assistance with structured coaching on grant writing. Participants in the experimental group additionally received training on how to cultivate their developmental networks; and received one-to-one guidance from a developer, a senior investigator whose primary purpose was to help the investigator reflect on and develop actionable plans to broaden their developmental network relationships. The end-product of this training program was the formation of an action plan to invite new developers into their network, and cull one or more relationships that no longer promote ongoing development.

We collected data from participants in both groups at two different time points over three years. The first solicitation (Time 1) occurred before receiving any training or education through the program. The second solicitation (Time 2) occurred six months after forming the developmental networks. Network and career outcome data were collected from the Time 1 and 2 surveys. In each survey, the participants provided information about their current developmental network.

Developmental Network (DN) training was administered through a series of workshops aimed at increasing participants' knowledge of developmental networks; and providing them with encouragement, skills, support, and strategies to build effective developmental relationships. This approach consisted of pre-work including completion of a preliminary survey and a professional developmental plan; then five 50-minute webinars discussing topics including 1) defining a developmental network, 2) identifying potential developers aligned with career goals, 3) initiating and cultivating new developmental relationships, 4) being an effective mentee, and 5) maintaining the developmental relationship over time.

The DN workshops were delivered remotely via Zoom, a video-conferencing platform that facilitates synchronous and asynchronous interactions between peers and coaches. During each webinar, frameworks were discussed, and examples were provided of how developmental network relationships can benefit one's career trajectory. Participants were also invited to share the strengths and weaknesses of their current developmental networks and discuss how these limitations could be remedied.

Results

Data and Analytical Approach

Data were collected at each time point for every individual and included several demographic characteristics as well as information on their mentors. The mentorship information was processed into networks for each participant, and several network characteristics were produced from each egocentric network. We then analyzed differences in network characteristics based on binary characterizations of the demographic traits of our individual participants. To analyze differences by each grouping, we ran a series of Fisher's exact tests; we opted for a non-parametric test due to the lack of normally distributed data as well as our small sample sizes. Fisher's exact test requires a two-by-two table, so both the demographic traits and network characteristics were binarized. The statistics were set to 0 for those individuals with below average statistical values and 1 for those individuals with at or above average network statistics, for each individual network measure. This analysis was conducted for each within-time sample and for the change in statistics over time for our 29 participants who responded to both surveys. Table 3 shows summary statistics for each sample, while Tables 4 through

6 show the p-values for the Fisher's exact tests; further description of each significant finding is discussed below.

Experimental Groups

The participants were divided into two groups, the experimental and control group, with the experimental group receiving additional mentorship training. At Time 1, before the start of the experiment, more of the individuals in the experimental group (M = 1.27) than the control group (M = 1.43) had below-average tie strength between those mentors that had relationships (p = .07), had above average tie age (experimental M = 7.68; control M = 5.85, p = .08), had above average network range (experimental M = 1.97; control M = 1.81, p = .08), and had above average discipline homophily (experimental M = .59; control M = .40, p = .02). This means that before the intervention, the experimental group had weaker and older networks with a greater mix of personal and professional mentors and a narrower disciplinary focus. After the intervention, these differences no longer were present – in fact, there were no statistical differences between the experimental group and the control group at Time 2. This suggests that participating in the workshop series and mentorship program helped investigators in the experimental group hone their developmental networks to meet their current mentorship needs more accurately.

Gender

At Time 1, more men than women participating in this research had an above average range (p = .10), indicating that members of their networks represented a wider array of social domains. In contrast, more women had above-average gender homophily (p < .01), meaning their networks had a higher percentage of same gender mentors on average. Both gender differences disappeared at Time 2. The only significant gender difference at Time 2 was that more women than men participating in the research had above-average discipline homophily (p = .05), meaning that more of their mentors share the same academic discipline as them.

Ethnicity

The major differences by ethnicity are present for Asian and White participants. At Time 1, a larger proportion of Asian participants had below-average network density (p < .01), below-average degree (p = .02), above-average degree centralization (p = .01), and lower overall tie strength (p = .04). After the intervention, these differences no longer were present, but a larger proportion of Asian individuals did have below-average range and below-average personal support (p = .03), both of which likely point to a focus on professional networks. For White individuals at Time 1, most had below-average professional support (p = .06), whereas a majority of non-White individuals had at or above-average professional support. This difference no longer was present at Time 2, but a larger proportion of White individuals did have below-average network density (p = .07), below-average overall tie strength (p = .03), below-average median tie age (p = .02), and below-average network range (p = .06), indicating that, compared to participants of minority ethnic groups, White participants' developmental networks were younger, weaker, and representative of fewer social domains. This suggests that White participants may have implemented greater network change from Time 1 to Time 2.

Grant Type

At Time 1, a higher proportion of individuals applying for R-type grants - shorter-term grants to engage in basic research - had below-average professional support (p = .07), personal support (p < .00), and discipline homophily (p = .07). In contrast, there was a higher proportion of individuals with at or above-average professional support (p = .09), and personal support (p = .01), among those applying for the K-type grants. Such higher levels of support are valuable for individuals applying for K-type grants, as these grants are longer-term awards supporting investigators seeking to establish an independent research program. At Time 2, only the differences in personal support remained (p = .05).

Discussion

The primary objective of the present study was to emphasize the various elements that can impact developmental networks and explore strategies for optimizing mentorship relationships to advance individuals' careers in academic medicine. Our argument commenced with the notion that examining the composition and structure of a focal individual's developmental network would empower that individual to proactively build a network of developers well suited to their career needs.

In the professional sphere, organizations need to cultivate an environment that promotes the growth of developmental networks by providing training, fostering an understanding of their significance, and teaching individuals how to enhance them. For instance, early-career investigators in medicine would benefit from thoroughly evaluating their current developmental network and opportunities to improve it.

During our training conversations, we provided early-career investigators with exercises to prompt self-reflection on the factors contributing to their current situation, such as career goals, group affiliations, and standing within their organization. Education and training have enabled scholars to comprehend their developmental needs better,

empowering them to articulate these needs when engaging with existing and potential developers in their network.

This study offers a significant initial exploration into the largely uncharted field of the long-term outcomes of developmental networks for early-career investigators in academic medicine. In particular, our longitudinal investigation involved participants' development throughout their early years in the workforce, enabling us to gain insight into the early-career stage, a critical and formative period for professional identity development (Ibarra 1999; Schein 1978). Further, our research makes a noteworthy contribution by focusing on an intriguing yet understudied aspect of career outcomes: The clarity of professional identity and subjective career success.

Implications for Theory

This study contributes to the existing literature in two main areas. First, it focuses on mentoring, specifically the developmental network model, which is a relatively new framework in mentoring research. Our assumption that people change over time through developmental networks aligns with the relational view in career theory (Hall et al., 1996). There is a need to understand how career development in academic science is influenced by the cultivation of critical developmental relationships over time. Further research into the dynamics of network structures and the content of the help provided by developmental relationships would provide valuable insights into the proposed developmental network structures and their potential impact on career advancement opportunities, including research proposal development and funding.

Furthermore, this study extends traditional career research by examining the experiences of early-career investigators across different organizational contexts, and by exploring developmental networks beyond the boundaries of a single organization (Arthur & Rousseau, 1996; Higgins, 2005; Sullivan, 1999). By doing so, the present study contributes to understanding the subjective aspects of careers and the clarity of professional identity, which transcends organizational boundaries. Our research also highlights the importance of developmental relationships and how they evolve as scholars advance in their careers, change affiliation as junior faculty, and shift their career aspirations toward greater research independence.

The findings of this study are noteworthy as they provide insight into the mentorship relationships of early-career investigators in academic medicine and the effect of curriculum focused on the value on mentoring and networks on developing these mentorship ties; however, several limitations should be considered. First, a larger sample size would enhance the generalizability and precision of our results. The study examined developmental network structures, potentially failing to capture the full intricacy of career development. Finally, the study was conducted during the COVID-19 pandemic, which may have restricted social interaction and limited opportunities for expanding developmental networks. Given that the study sample size of each cohort decreased, the COVID-19 crisis also may have hindered the progression of the developmental networks.

The present study is also limited by its use of graduating early-career investigators from various institutions around the United States. Given the homogeneity of this population in terms of education and institutional affiliation, we might expect individuals' density dynamics to be strikingly similar. We found that density tended to depend on career focus, with those interested in basic science having more dense networks. These findings highlight the differences in the mentorship networks needed by investigators who draw on more narrow disciplinary influences in their work.

As detailed here, a significant drawback of this workshop series and mentorship program is the need for follow-up with participants to assess their progress toward more tangible career objectives. The longitudinal nature of this study means that data collection is ongoing; This follow-up process is in progress. Additionally, although discussions on developmental networks were accessible to members in the experimental group, the diverse nature of organizational contexts and career aspirations might have impeded the establishment of shared ground during these conversations. Nonetheless, we anticipate that individual meetings will prove beneficial in helping participants recognize recurring themes and patterns in devising strategies to develop mentorship networks that would align with their career goals. We also anticipate that the expansion of the developmental networks of those in the experimental condition may continue, and that a longer window of network assessment may be necessary to understand the evolution of the mentorship ties fully.

Conclusion

Research institutions can facilitate scientific progress by providing training and development programs for early-career investigators in basic biomedical, behavioral, and clinical research. This study examined the impact of a professional development program providing education and support to early-career investigators for building their own developmental networks. The approach of this program differs from that of initiatives promoting a conventional mentorship model - which typically involves only the focal individual and one mentor – in that the present approach facilitates a mesh of multiple developers whom early-career investigators can turn to for guidance. By utilizing the training and education outlined in this paper, early-career investigators can cultivate responsive networks that address their research needs. This model emphasizes the individual's

responsibility for evaluating and reassessing their career development requirements, with the early-career investigator at the core. This study provides preliminary insights into the character of these developmental networks for investigators with different career goals (R-type and K-type) and how these networks evolve, impacting career prospects and potential future research funding.

References

Arthur, M. B. and Rousseau, D. M. (1996). A career lexicon for the 21st century. *Academy of Management Perspectives, 10*(4), 28-39.

Burt, R. S. (2002). The social capital of structural holes. *The new economic sociology: Developments in an emerging field, 148*(90), 122.

Cummings, J. N., & Higgins, M. C. (2006). Relational instability at the network core: Support dynamics in developmental networks. *Social Networks, 28*(1), 38-55.

Dreher, G. F., & Ash, R. A. (1990). Comparative study of mentoring among men and women in managerial, professional, and technical positions. *Journal of Applied Psychology, 75*(5), 539.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360-1380.

Higgins, M. C., & Kram, K. E. (2001). Reconceptualizing mentoring at work: A developmental network perspective.
(2), 264-288.

Higgins, M. C., & Thomas, D. A. (2001). Constellations and careers: Toward understanding the effects of multiple developmental relationships. *Journal of Organizational Behavior,*

Ibarra, H. (1992). Homophily and differential returns: Sex differences in network structure and access in an advertising firm. *Administrative Science Quarterly*, 422-447.

Ibarra, H. (1993). Personal networks of women and minorities in management: A conceptual framework. *Academy of Management Review, 18*(1), 56-87.

Ibarra, H. (1995). Race, opportunity, and diversity of social circles in managerial networks. *Academy of Management Journal, 38*(3), 673-703.

Kram, K. E. (1985). Improving the mentoring process. *Training and Development Journal, 39*(4).

Levinson, D., Darrow, C., Klein, E., Levinson, M., & McKee, B. (1978). *The seasons of man's life.* Knopl.

Hemming, J. J., Baez, A., Hall, M., Thompson, W., Stiles, J., & Ofili, E. (2019). Advancing health equity through organizational mentoring policies at minority-serving institutions. *Ethnicity & Disease, 29*(2), 371-376

Hewlett, S. A. (2013). *Forget a mentor, find a sponsor: The new way to fast-track your career.* Harvard Business Review Press.

Illes, J., Glover, G. H., Wexler, L., Leung, A. N., & Glazer, G. M. (2000). A model for faculty mentoring in academic radiology. *Academic Radiology, 7*(9), 717-724.

Levinson, D. J., Darrow, C. M., Klein, E. B., Levinson, M. H., & McKee, B. (1976). Periods in the adult development of men: Ages 18 to 45. *The Counseling Psychologist, 6*(1), 21-25.

Li, C. S., Goering, D. D., Montanye, M. R., & Su, R. (2022). Understanding the career and job outcomes of contemporary career attitudes within the context of career environments: An integrative meta-analysis. *Journal of Organizational Behavior, 43*(2), 286-309.

Morrison, E. W. (2002). Newcomers' relationships: The role of social network ties during socialization. *Academy of Management Journal, 45*(6), 1149-1160.

Marcinkus Murphy, W., & Kram, K. E. (2010). Understanding non-work relationships in developmental networks. *Career Development International, 15*(7), 637-663.

National Academies of Sciences, Engineering, and Medicine; Policy and Global Affairs; Board on Higher Education and Workforce; Committee on Effective Mentoring in STEMM; Dahlberg, M. L., & Byars-Winston, A. (Eds.) (2019). Science of effective mentorship in STEMM. National Academies Press (US). In The science of mentoring relationships: What is mentorship? https://www.ncbi.nlm.nih.gov/books/NBK552775/

Ofili, E. O., Tchounwou, P. B., Fernandez-Repollet, E., Yanagihara, R., Akintobi, T. H., Lee, J. E., ... & Members, R. T. (2019). The Research Centers in Minority Institutions (RCMI) Translational Research Network: Building and sustaining capacity for multi-site basic biomedical, clinical and behavioral research. *Ethnicity & Disease, 29*(Suppl 1), 135.

Ofili, E. O., Sarpong, D., Yanagihara, R., Tchounwou, P. B., Fernández-Repollet, E., Malouhi, M., ... & Rivers, B. M. (2021). The Research Centers in Minority Institutions (RCMI) Consortium: A blueprint for inclusive excellence. *International Journal of Environmental Research and Public Health, 18*(13), 6848.

Palepu, A., Friedman, R. H., Barnett, R. C., Carr, P. L., Ash, A. S., Szalacha, L., & Moskowitz, M. A. (1998). Junior faculty members' mentoring relationships and their professional development in US medical schools. *Academic Medicine: Journal of the Association of American Medical Colleges, 73*(3), 318-323.

Pearce, C. L. (2007). The future of leadership development: The importance of identity, multi-level approaches, self-leadership,

physical fitness, shared leadership, networking, creativity, emotions, spirituality and on-boarding processes. *Human Resource Management Review, 17*(4), 355-359.
Ransdell, L. B., Lane, T. S., Schwartz, A. L., Wayment, H. A., & Baldwin, J. A. (2021). Mentoring new and early-stage investigators and underrepresented minority faculty for research success in health-related fields: An integrative literature review (2010–2020). *International Journal of Environmental Research and Public Health, 18*(2), 432.
Sambunjak, D., Straus, S. E., & Marušić, A. (2006). Mentoring in academic medicine: A systematic review. *Jama, 296*(9), 1103-1115.
Schein, E. H. (2010). *Organizational culture and leadership* (Vol. 2). John Wiley & Sons.
Sullivan, S. E. (1999). The changing nature of careers: A review and research agenda. *Journal of management, 25*(3), 457-484.
van Emmerik, I.J.H. (2004) 'The more you can get the better: Mentoring constellations and intrinsic career success', *Career Development International, 9*(6): 578–94.
Van Maanen, J. E., & Schein, E. H. (1977). Toward a theory of organizational socialization.
Weber-Main, A. M., McGee, R., Eide Boman, K., Hemming, J., Hall, M, Unold, T., Harwood, E. M., Risner, L. E., Smith, A., Lawson, K., Engler, J., Steer, C. J., Buchwald, D., Jones. H. P., Manson, S. M., Ofili, E., Schwartz, N. B., Vishwanatha, J. K., Okuyemi, K. S. (2020). Grant application outcomes for biomedical researchers who participated in the grant writing coaching program of the National Research Mentoring Network. *PLoS ONE, 15*(11), e0241851. https://doi.org/10.1371/journal.pone.0241851
Yanagihara, R., Berry, M. J., Carson, M. J., Chang, S. P., Corliss, H., Cox, M. B., ... & Wiese, T. E. (2021). Building a diverse workforce and thinkforce to reduce health disparities. *International Journal of Environmental Research and Public Health, 18*(4), 1569.

Appendix

Table 1
Descriptive Statistics

	Density	Degree	Degree Central.	Tie Strength	Tie Strg. Present	Mean Age	Median Age	Range	Race (H)	Gender (H)	Discipline (H)	Professional Resources	Personal Resource
Time 1													
Control	0.56	4.56	0.33	1.43	2.48	5.85	4.55	1.81	0.39	0.48	0.40	5.27	5.61
Experimental	0.56	4.53	0.31	1.27	2.26	7.68	5.86	1.97	0.44	0.54	0.59	5.42	5.78
Total	0.56	4.54	0.32	1.33	2.35	6.92	5.32	1.91	0.42	0.51	0.51	5.36	5.71
Time 2													
Control	0.51	4.00	0.30	1.22	2.46	6.64	5.93	1.86	0.55	0.57	0.38	5.56	6.05
Experimental	0.58	4.14	0.38	1.38	2.39	6.10	5.30	1.64	0.53	0.58	0.55	5.17	5.51
Total	0.55	4.08	0.35	1.32	2.41	6.33	5.56	1.72	0.54	0.57	0.49	5.32	5.72

Note: (H) indicates homophily terms

Table 2
Summary of demographic characteristics

	Gender	Assistant	Postdoc	Basic	Clinical	Social	Asian	White	Black	Latinx	R-Type	K-Type
Time 1												
Control	0.41	0.81	0.04	0.26	0.37	0.37	0.04	0.33	0.37	0.19	0.74	0.15
Experimental	0.32	0.66	0.18	0.32	0.39	0.24	0.24	0.08	0.34	0.21	0.50	0.37
Total	0.33	0.64	0.20	0.29	0.38	0.29	0.13	0.23	0.32	0.21	0.60	0.28
Time 2												
Control	0.07	0.71	0.14	0.14	0.43	0.29	0.07	0.36	0.29	0.14	0.64	0.21
Experimental	0.32	0.73	0.18	0.36	0.36	0.27	0.23	0.05	0.45	0.23	0.50	0.45
Total	0.21	0.64	0.24	0.28	0.39	0.28	0.14	0.24	0.36	0.19	0.56	0.36
Matched Sample												
Control	0.20	1.00	0.00	0.10	0.60	0.30	0.00	0.50	0.20	0.20	0.80	0.20
Experimental	0.32	0.79	0.16	0.37	0.42	0.21	0.26	0.05	0.42	0.21	0.47	0.47
Total	0.28	0.86	0.10	0.28	0.48	0.24	0.17	0.21	0.34	0.21	0.59	0.38

Table 3

Average Changes Over Time

	Density	Degree	Degree Central.	Tie Strength	Tie Strg. Present	Mean Age	Median Age	Range	Race (H)	Gender (H)	Discipline (H)	Professional Resources	Personal Resource
Control	-0.04	-0.60	0.00	-0.20	-0.26	1.05	1.48	-0.30	0.03	-0.04	0.03	0.72	0.49
Experimental	-0.02	-0.37	0.04	0.00	-0.10	0.02	0.41	-0.37	0.11	0.03	-0.03	-0.25	-0.13
Total	-0.03	-0.45	0.02	-0.07	-0.15	0.41	0.81	-0.34	0.08	0.00	-0.01	0.08	0.09

Note: (H) indicates homophily terms

Table 4

Results of Fisher's Exact Test for Time 1

	Density	Degree	Degree Central.	Tie Strength	Tie Strg. Present	Mean Age	Median Age	Range	Race (H)	Gender (H)	Discipline (H)	Professional Resources	Personal Resource
Group	0.32	0.72	1.00	1.00	0.07	0.08	0.43	0.08	0.45	0.62	0.02	0.20	0.80
Gender	0.47	1.00	0.33	1.00	0.62	1.00	0.20	0.10	0.79	0.00	0.20	1.00	1.00
Asian	0.00	0.02	0.01	0.04	1.00	1.00	1.00	1.00	1.00	0.51	0.50	1.00	0.19
White	0.78	0.44	0.42	1.00	0.59	0.05	0.15	0.75	0.11	0.21	0.21	0.06	1.00
Black	0.33	0.03	0.22	0.80	0.80	1.00	0.61	0.56	0.79	0.30	0.80	0.22	0.81
Latinx	0.78	1.00	0.78	0.58	0.78	0.41	1.00	0.75	0.76	0.76	0.76	1.00	0.57
R-Type	0.31	0.73	0.80	0.32	0.80	1.00	0.60	1.00	0.31	1.00	0.07	0.07	0.00
K-Type	0.18	1.00	0.78	1.00	0.58	0.79	1.00	1.00	0.17	0.59	0.26	0.09	0.01

Note: Darker shades of blue correspond to p-value cutoffs of $p < 0.05$, $p < 0.01$, and $p < 0.001$; (H) indicates homophily terms

Table 5

Results of Fisher's Exact Test for Time 2

	Density	Degree	Degree Central.	Tie Strength	Tie Strg. Present	Mean Age	Median Age	Range	Race (H)	Gender (H)	Discipline (H)	Professional Resources	Personal Resource
Group	0.50	1.00	0.50	0.73	0.47	1.00	0.72	1.00	0.73	1.00	0.31	0.29	0.18
Gender	0.46	0.70	0.14	0.71	1.00	0.69	0.41	0.71	1.00	0.71	0.05	1.00	0.72
Asian	0.69	0.35	0.38	1.00	1.00	0.32	0.15	0.02	0.68	1.00	0.20	0.38	0.03
White	0.07	0.47	0.00	0.03	0.71	1.00	0.02	0.06	0.72	1.00	1.00	0.46	0.49
Black	0.52	0.31	0.05	0.12	1.00	0.74	0.31	0.75	0.50	0.50	0.31	0.33	0.74
Latinx	0.43	0.23	0.11	0.71	0.40	0.39	0.41	0.45	1.00	1.00	1.00	0.22	0.11
R-Type	1.00	0.48	1.00	1.00	1.00	1.00	0.29	0.52	0.04	0.52	0.52	1.00	0.05
K-Type	0.74	0.14	1.00	0.74	1.00	0.47	0.27	0.73	0.09	0.73	0.30	1.00	0.08

Note: Darker shades of blue correspond to p-value cutoffs of $p < 0.05$, $p < 0.01$, and $p < 0.001$; (H) indicates homophily terms

Table 6

Results of Fisher's Exact Test for Changes Over Time

	Density	Degree	Degree Central.	Tie Strength	Tie Strg. Present	Mean Age	Median Age	Range	Race (H)	Gender (H)	Discipline (H)	Professional Resources	Personal Resource
Group	0.69	1.00	0.69	0.43	1.00	0.42	0.69	0.31	0.71	1.00	0.70	0.02	0.45
Gender	1.00	1.00	1.00	1.00	1.00	1.00	0.44	1.00	0.70	0.24	1.00	0.06	0.11
Asian	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.56	0.34	0.14	0.63	0.66	0.37
White	1.00	0.54	0.22	0.70	0.69	0.72	0.71	0.16	0.06	0.18	0.63	0.06	1.00
Black	0.71	1.00	0.70	0.46	0.44	1.00	0.07	1.00	0.71	1.00	1.00	0.29	0.72
Latinx	1.00	1.00	0.38	1.00	1.00	1.00	1.00	0.30	0.66	1.00	0.63	1.00	0.03
R-Type	1.00	0.55	0.44	0.72	0.24	1.00	0.71	0.62	0.72	0.72	1.00	0.71	0.70
K-Type	1.00	0.54	0.70	1.00	0.11	0.71	0.69	0.34	0.47	1.00	1.00	0.45	0.72

Note: Darker shades of blue correspond to p-value cutoffs of $p < 0.05$, $p < 0.01$, and $p < 0.001$; (H) indicates homophily terms

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