

Mapping a Mentoring Roadmap and Developing a Supportive Network for Strategic Career Advancement

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Abstract

This article presents a proactive, individual-centered mentoring model which meets a recognized need for defined, practical methods for supporting comprehensive career planning and strategic development grounded in personal career aspirations. The developed model consists of a mentoring roadmap charting process and construction of a developmental mentoring network based on an integrative literature review of successful mentoring practices and adaptation of tested methods for retrospective analyses of effective mentoring. The mentoring roadmap concept encompasses the following steps: (a) self-reflection, (b) establishment of mentor–mentee relationship(s), (c) maintenance of mentoring relationships, and (d) advancing in mentoring relationship(s). To support strategic advancement along a defined mentoring roadmap and toward attainment of individual goals, the identification and cultivation of a broad collection of mentoring resources or mentors (i.e., nodes) and the relationships (i.e., edges) which connect these nodes in an effective mentoring network topology are discussed. The mentoring roadmap and network model is proposed as complementary to top-down or formal organizational mentoring interventions and as effective for short- and long-term career development planning as a self-guided assessment or mentor-engaged tool to support individuals seeking mentoring.

Keywords

career development, mentor network mapping, mentoring, mentoring network, mentoring roadmap, professional development

Introduction

Mentoring has been widely recognized as one of the key factors contributing to skills development, psychosocial or socio-emotional support, and career advancement and success (Haggard, Dougherty, Turban, & Wilbanks, 2011; Jacobi, 1991; Kram, 1985; Packard, 2016). As such, effective mentoring can contribute to increased self-efficacy and effectiveness (Kram, 1985) and improved and expanded skills and competencies (Jacobi, 1991), which can support individual advancement, including in educational and career domains. In the context of careers, mentoring is often viewed from a top-down or hierarchical perspective in which a senior individual or organization-sponsored mentor provides information needed for an individual to recognize and achieve defined milestones required for success in a specific context (Redmond, 1990). In this regard, top-down mentoring serves effectively to socialize individuals to organizational norms during pursuit of success (Ensher, Thomas, & Murphy, 2001). Recently, however, there has been an increasing appreciation that mentoring centered in the needs and personal aspirations of individuals can empower individuals toward personally-defined career advancement (Rockquemore, 2013). Such individual-centered mentoring is

best served by developing a network of mentors (Higgins & Kram, 2001; Rockquemore, 2013; Sorcinelli & Yun, 2007). Notably, both forms of mentoring contribute to success, with top-down mentoring having greater implications for short-term career outcomes and individually-driven, network-based mentoring having been shown to support long-term career goals, advancement, and retention (Higgins & Thomas, 2001).

Despite a general recognition of the importance of mentoring, there is a dearth of established, evidence-based tools for guiding individuals in determining their personal mentoring needs and/or establishing effective mentoring networks to support their aspirations and professional growth in an individual-centered mentoring framework. Herein, a review of mentoring literature is engaged to support the development of an individual-centered mentoring model for guiding

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comprehensive career planning and strategic development based on personal career aspirations. The developed mentoring roadmap and network model includes an individual mentoring roadmap tool based on mapping self-identified needs and career goals. The mapping process includes an assessment of a personal need for mentoring to support successful advancement along a career roadmap. The process and benefits of mapping a personal mentoring network to support comprehensive career planning and progress along a defined trajectory are delineated. To facilitate development of a suitable support network, a mentoring network mapping tool is presented. The network construction model is based primarily on adapting tested methods used to evaluate qualitative data from interviews or surveys related to retrospective analyses of success in individual careers (Long et al., 2013) and a scholarship of integration approach (Boyer, 1990) to incorporate knowledge derived from effective mentoring (e.g., Haggard et al., 2011) and developmental mentoring models (Kram, 1985; Megginson, Clutterback, Garvey, Stokes, & Garrett-Harris, 2006; Washington & Cox, 2016). This mentoring network tool is useful by mentees for self-assessment or as a planning or progress assessment tool in mentoring relationships. Rather than a focus on “retrospective sense-making” about mentoring (Higgins & Thomas, 2001, p. 230), this approach meets a recognized need for defined practices to support cultivating multiple developmental relationships or a mentoring network to support long-term career advancement (Higgins & Thomas, 2001). The described roadmap charting and network construction tools enable proactive sense-building regarding personal mentoring needs and the supportive mentoring networks needed to support specific individuals. A review of relevant literature is provided throughout the text to present the theoretical underpinning and to support the development and use of the mentoring roadmaps and networks model.

Mentoring and Mentors Defined

What Is a Mentor?

There are myriad definitions of mentor available (Haggard et al., 2011). These definitions often engage the concept of a senior or experienced individual who provides advice and guidance to a novice, or individual with limited experience, in a particular domain. Mentoring in this top-down framework then emerges as interactions, largely based on a one-way flow of information, between a mentor and an individual being mentored (i.e., a mentee). The focus of the mentoring can include a range of goals, including skills or competency development, psychosocial or socioemotional support, and career development (Haggard et al., 2011; Jacobi, 1991; Kram, 1985). Alternative forms of mentoring, including peer mentoring (Driscoll, Parkes, Tilley-Lubbs, Brill, & Pitts Bannister, 2009; Eby, 1997; Kroll, 2016) and group mentoring (Eby, 1997; Kroll, 2016; Montgomery, Dodson, & Johnson, 2014;

Varkey et al., 2012), also serve as effective means to realize these goals. Some of these alternative models move toward bidirectional engagement of mentor and mentee, which has been shown to improve mentoring outcomes in many cases (Sorcinelli & Yun, 2009). Bilateral engagement is particularly important as such exchanges promote adapting mentoring to individual mentee goals and needs. Thus, a working concept, or functional approach, to conceptualizing mentors and mentoring begins to emerge, which is distinguished here from advising or more classically defined top-down hierarchical mentoring (Yun & Sorcinelli, 2009), both of which are typically designed to facilitate progress by advisees or mentees toward organizationally defined goals.

Mentors versus advisors. Advisors tell any individual what steps or activities are needed to complete a task, degree, or attain tenure or promotion (Baker & Griffin, 2010; Montgomery et al., 2014; Ramirez, 2012). In this regard, advising is instruction or guidance that would benefit *any* student pursuing a particular educational course or *any* individual on a particular career path. Advising, then, centers on providing factual information about the particular activities that must occur to complete an educational course of study or actions pertinent to any individual pursuing a particular career or goal-directed trajectory (Montgomery et al., 2014). Advising, though necessary and highly desirable in many cases, is largely a one-way transfer of information from advisor to advisee in pursuit of an organizationally specific context of success. In this sense, many forms of top-down “mentoring” can appear to more aptly fit a role of advising of individuals toward organizational norms or institutionally driven goals for individual workers and their contextual success.

By contrast, mentoring is positioned as a distinct and deeper engagement that is based on a thorough personal understanding of one’s mentee and that individual’s personal career aspirations. Mentoring very frequently includes some advising, yet transcends advising in its provision of individual-specific information and bilateral engagement and interactions that include the offering of advice based on a deep personal understanding of the mentee’s cadre of prior experiences, strengths and weaknesses, personal aspirations, values, and professional goals (Montgomery et al., 2014). The investment of a mentor in getting to know the personal strengths and weaknesses of an individual—“learning” the person (Montgomery, 2015a)—allows the mentor to address an individual’s unique needs in the mentoring relationship (Baker & Griffin, 2010; Kirchmeyer, 2005; Montgomery et al., 2014; Ramirez, 2012). This learning includes gaining an understanding of the individual’s strengths and weaknesses to the degree that a mentor can suggest and help guide the mentee along a path of action that engages and capitalizes on the mentee’s strengths, while providing opportunities to improve recognized weaknesses for the benefit of personal growth and successful attainment of educational and/or career goals. Effective mentoring may, and perhaps *should*,

also engage personal values of the mentee and mentor. Such a values-based focus provides an opportunity for personalized mentoring with a goal of promoting improved outcomes for individual mentees, yet also addresses the recognition that differing values can lead to conflicts or differences in expectations that can impede or derail mentoring exchanges. Thus, impactful mentoring focuses deeply on personal growth as one recognizes and considers the whole person, and also seeks to support an individual's values-based personal advancement in a specific domain (Montgomery, 2015b). This individual-centered view of mentoring is distinct from many top-down approaches, which again can very often reflect an advising perspective associated with specific and often time-delimited goals related to instrumental facets of career success (Lewis & Olshansky, 2016), and in fact often meet the needs of a smaller part of one's comprehensive and career-long mentoring needs.

Lifeline of Mentoring

The attainment of comprehensive mentoring to support an individual's mentoring needs is a process. It is a process, however, that has identifiable elements that comprise stations along a lifeline of mentoring. A specific individual's mentoring lifeline is based on particular goals or milestones paired with the individual mentoring capital required for achievement of personal career aspirations. An individual mentee has many needs at any one station or along the trajectory of the mentoring lifeline and to successfully traverse the lifeline requires a complex and comprehensive set of mentoring resources and expertise.

Multiple roles versus multiple mentors? Mentors can fill many roles, including the provision of practical advice about careers or a course of study, contributions to professional development, or dissemination of political guidance and strategies (Montgomery et al., 2014). In all of these engagements, there is a need for mentors who understand an individual's personal commitments, values, and future goals to provide the most efficacious mentoring. To support complex mentoring needs, people often seek a comprehensive mentor. However, the wide range of areas to which mentors can make contributions suggests that mentors either have to serve effectively in multiple roles or alternatively that mentees need to engage multiple mentors, each with specific strengths and/or expertise, to gain the comprehensive mentoring needed. Thus, the focus of mentoring should shift to the goal of assembling comprehensive mentoring, which may—and perhaps *should*—include input from multiple mentors rather than seeking a single individual to fill multiple roles as a comprehensive “guru” mentor (Chesler & Chesler, 2002; de Janasz & Sullivan, 2004; Ensher et al., 2001; Grant, 2015; Long et al., 2014; Long et al., 2013; R. McGee, Lee, Pfund, & Branchaw, 2015; Packard, 2016; Packard, Kim, Sicley, & Piontkowski, 2009; Rockquemore, 2013; Sorcinelli & Yun,

2007; Wilson et al., 2012; Zambrana et al., 2015). There are many formats for gaining access to comprehensive mentoring, including collective mentoring by a group of preassembled individuals (Blue, 2001; Chesler & Chesler, 2002; Davidson & Foster-Johnson, 2001; Dodson, Montgomery, & Brown, 2009; Eby, 1997; R. McGee, Saran, & Krulwich, 2012; Montgomery et al., 2014; Smith, Cech, Metz, Hunt-oon, & Moyer, 2014), as well as the alternative of assembling a personal collection of mentors into a mentor network that is strategically constructed to serve the comprehensive needs of any particular mentee (Hetty van Emmerik, 2004; Higgins & Kram, 2001; Long et al., 2013; Sorcinelli & Yun, 2007; Trube & VanDerveer, 2015; Zambrana et al., 2015). Based on longitudinal analyses of mentoring relationships, the engagement of mentoring networks has been associated with long-term career outcomes, whereas top-down approaches more effectively support short-term career goals (Higgins & Thomas, 2001). Despite the recognized value of mentoring networks for supporting long-term career outcomes, practical mechanisms for enacting the building of individual mentoring networks to complement the provision of an organizational mentor are limited. Based on theoretical frameworks introduced in the literature, a model for mapping an individual mentoring roadmap is introduced and followed with a description of the building and sustaining of mentoring networks that support comprehensive career planning and strategic development for individuals. The roadmap charting and network construction processes include both descriptions of specific mentoring types and resources (i.e., nodes of the mentoring network) and the mentoring relationships that connect the individual mentee with identified resources (i.e., edges in the network).

Constructing a Mentoring Roadmap

An individual's mentoring roadmap draws on the lifeline of mentoring concept that consists of identifiable stations along a planned career trajectory. The mapping out of these stations is based on the consideration of driving questions and the path from one station to the next comprises what is referred to as the drafting or charting of a complete mentoring roadmap. Despite its simplified depiction (Figure 1), the mentoring roadmap is intended as nonlinear. The path starts with, and returns frequently to, self-reflection which is absolutely critical as a starting point in the individual-centered mentoring model as a means to identify individual mentoring needs based on self-defined career goals. From self-reflection, the roadmap progresses to the establishment and maintenance of mentoring relationships, and then proceeds to considerations of advancing in mentoring relationships as progress with career development or other goals are achieved. Ultimately, the “moving ahead” portion of the roadmap includes consideration of renegotiating and/or ending mentoring relationships, as needed (Figure 1). Such mentoring roadmaps have immense potential for supporting both short-term and long-term personal

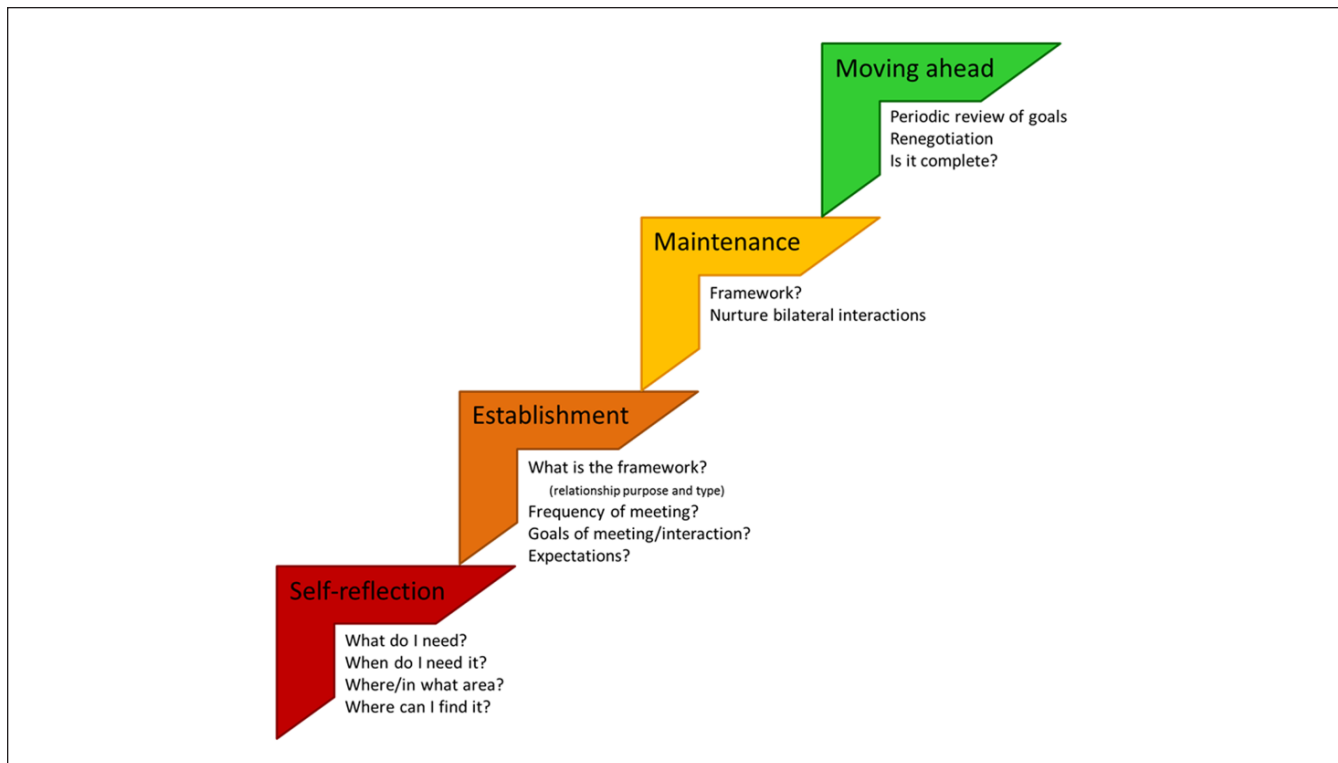


Figure 1. Elements of a mentoring roadmap.

Note. This figure illustrates the stages or stations included in a mentoring roadmap, including self-reflection, establishment, maintenance, and moving ahead. Pertinent guiding questions or considerations for each stage are represented below each major area. Although depicted in a linear progression, the roadmap is not unidirectional and revisiting steps such as self-reflection should occur periodically.

envisioning regarding one's individual mentoring needs, or the recognition of mentoring needs and provision of mentoring capital from the perspective of the mentor when used as planning or progress assessment tool. The process of composing a personalized roadmap using driving questions and based on insights from the mentoring literature is described.

Self-Reflection

What do I need and why do I need it? Self-reflection is a start pointing for individuals to identify mentoring needs related to their personal aspirations. Without a clear understanding of what support is specifically needed to attain self-defined goals or in what specific areas support and mentoring are needed, how can an individual adequately identify the right source(s) or mentors for obtaining what is needed? A role for self-reflection or self-assessment in identifying professional mentoring needs or goals and suggested tools and professional development opportunities for targeted self-assessment have been recommended (R. McGee, Lee, et al., 2015; Sorcinelli & Yun, 2009; Tull & Tull, 2012). Self-reflection is of key importance to facilitate robust self-awareness about one's individual strengths and weaknesses and to cultivate an ability to receive constructive criticism. These are critical factors in being able to effectively engage in and benefit from robust mentoring relationships. Some tools have

emerged which are intended to facilitate strategic self-assessment, including versions of an individual development plan (IDP; Clifford, 2002; Vincent et al., 2015). The use of IDPs in particular has been supported as critical for promoting structured bilateral conversations between mentors and mentees (Faber, 2015; Vincent et al., 2015).

When do I need a resource? Having identified a core set of needs, another consideration is whether these are all needed simultaneously or whether resources can be engaged in specific phases. This is a critical consideration as it helps mentees identify when particular mentoring resources will need to be identified and engaged. This knowledge facilitates the prioritization of the search for mentor(s) and mentoring resources, which will serve as nodes in the building of a mentoring network (described below). This idea that not all resources are needed at once begins to draw on the idea that mentoring networks are dynamic in nature (Dobrow & Higgins, 2005). Attention to strategic management of the dynamics of one's access to mentor(s) and mentoring resources can support career success and advancement over time (Dobrow & Higgins, 2005; Uzzi & Dunlap, 2005).

Where or in what areas must the resource be located? The consideration of the identified areas of mentoring needs and whether these resources need ideally be local or can be

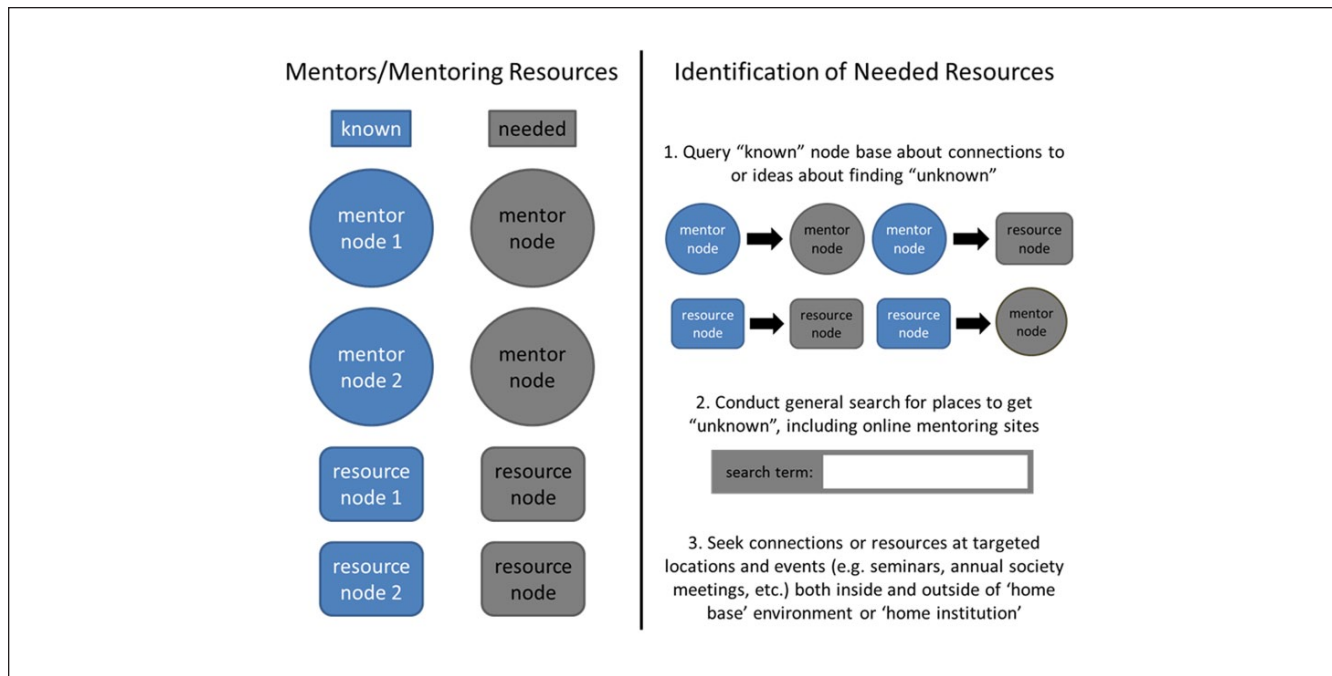


Figure 2. Identification of mentoring network resource nodes.

Note. Right, mentoring resources that serve as mentoring network nodes include known (shown in blue) and unknown or needed (shown in gray) resources. These nodes include human mentors (circles) and nonhuman resources (rectangles), examples of the latter include mentoring books, Internet resources, online courses, among others. Left, several ways to effectively identify needed resources are shown, which include querying known nodes to identify unknown mentors or resources, conducting information searches, or using engagement in target communities to connect with or identify nodes.

engaged from a distance is a vitally important one. Once specific needs are identified, the process of reviewing whether there are already individuals known to the mentee (i.e., known nodes; Figure 2) that can serve in a particular needed capacity can be engaged. If there are areas for which no resources are known, a specific plan for identifying these sources of mentoring can be formulated as discussed in detail below related to construction of mentoring networks (Figure 2). In addition, the availability of access to mentors or mentoring resources online is increasingly possible. Indeed, a growing number of electronic sources are available to aid in the identification of mentors or resources, the actual provision of mentoring that is needed, or to supplement information needed by the mentee in addition to heuristic knowledge needed locally (e.g., Blake-Beard, Bayne, Crosby, & Muller, 2011; Wadia-Fascetti & Leventman, 2000). Engagement of such mentoring resources can become a critical component of developing an individual plan for comprehensive mentoring.

Establishing and Maintaining Relationships

The initiation or establishment of mentoring relationships is the starting point for many classic and newer developmental mentoring models (Kram, 1985; Megginson et al., 2006; Washington & Cox, 2016). Whether directly following self-reflection as suggested here or as a first step, initiation begins with relationship building between mentee and mentors in

the network. To truly facilitate the attainment of comprehensive mentoring to support personal aspirations, mentoring resources and mentor(s) must be identified and effective relationships must be established and maintained through specific means. To facilitate the use of the roadmapping model, evidence related to distinct purposes and types of mentoring relationships that support progress along a career trajectory are described.

What is the framework? The framework of mentoring relationships should be defined from both the point of view of the mentee and the mentor and overlap or connections between the two should be optimized. Particular points to be addressed in establishing a shared understanding about the framework of a mentoring exchange include the preferred mode of contact, frequency and format of meetings, goals of meetings or planned interactions, and expectations (Cunningham, 1993). It is vitally important to pay attention to the expectations and responsibilities of each party in the mentoring exchange (Grant, 2015; Washington & Cox, 2016) and to be clear and specific about the goals and expectations for both the mentee and mentor. Where possible, it is important to establish measurable outcomes associated with the defined goals and expectations. To enable the reaching of a joint consensus about expectations or to facilitate compromise where individual needs and expectations of the mentee and mentor diverge, it is critical to arrive at a common understanding of both the

purpose of the mentoring exchange (Megginson et al., 2006) and *type* of mentoring relationships that will emerge to support this purpose and to promote effective engagement.

Establishing purpose of the mentoring exchange. The purpose of mentoring relationships can take many distinct forms, including a goal of comprehensive mentoring, that is a more traditional type of mentoring that typically indicates that one's total mentoring needs are being addressed largely by one individual in a particular mentoring relationship; maintenance mentoring, which can help one navigate or maintain success in a current placement; transitional mentoring, which can be critical when moving from one career stage or placement to another; or, aspirational mentoring, which often positions individuals to move toward a career or opportunity to which they aspire.

Comprehensive mentoring. Comprehensive mentoring can fulfill the complete mentoring needs of different types, at different times, and/or for different individual weaknesses and/or strength-building opportunities (Anderson, Silet, & Fleming, 2012; Griffin & Toldson, 2012). Finding all that one mentee needs in a single source is very unlikely, and thus here the quest for *comprehensive mentoring*, rather than finding a *comprehensive mentor*, is supported. Comprehensive mentoring can be obtained through the building of a multi-dimensional network that engages many different mentoring types and relationships. As each individual mentee will have different mentoring needs, each individual's comprehensive mentoring network will be uniquely constructed and maintained.

Maintenance mentoring. Maintenance mentoring is more specific in being critical for supporting the advancement of individuals that have committed to a particular course of study or career placement—to keep one moving toward accomplishment of a specific goal that may be part of a larger ongoing trajectory. In this regard, maintenance mentoring can be a smaller more defined portion of a comprehensive mentoring exchange in some cases. Maintenance mentoring is most parallel to the stage of mentoring described as cultivation in Kram's (1985) developmental mentoring framework. This type of mentoring provides the support needed to maintain one's placement and to complete a particular, and often time-delimited, portion of one's larger career path. The needs vary at particular portions of an individual's path and thus the person who may serve as a valuable and effective maintenance mentor at one stage may not be the same individual needed to maintain one's placement and performance at distinct stages. The particulars of maintenance mentoring needed specifically at different stages of the academic path have been recently discussed (Montgomery et al., 2014).

Transitional mentoring. Transitional mentoring is critically important when an individual is moving from one career

stage to another or from one type of environment to another. Such mentoring can be absolutely critical for initiating progress in a new role or position. It has been regularly recommended that special attention to the provision of mentoring during such transitions can support recruitment and retention of individuals broadly (Brown, 2011; Gibau et al., 2010; Malone & Barabino, 2009; E. O. McGee, Robinson, Bentley, & Houston, 2015; Stassun, Burger, & Lange, 2010; Stassun et al., 2011; Whittaker & Montgomery, 2012, 2014; Williams et al., 2011). Transitional mentors may be individuals with whom a mentee has a long-term association. Alternatively, this type of mentoring can very frequently be effectively accomplished through short-term transitional mentoring.

Aspirational mentoring. Aspirational mentoring can be based on mentoring needed for a future position or role to which one aspires, or based on future potential that an individual's mentor identifies or recommends. Aspirational mentoring is based on the concept of mentoring centered on gaining aspirational capital, defined by Yosso (2005) as one of six forms of cultural capital. Aspirational capital encompasses the ability of an individual to foster aspirations that appear to transcend what is possible based on the individual's current skill set, experiences, or station in life, or currently available resources (Yosso, 2005). In this regard, aspirational mentoring is comprised of the interactions with a mentor that facilitate mentees successfully, and hopefully strategically, navigating the gap between where they are currently and the role(s) and/or position(s) to which they aspire.

Defining the relevant type of mentoring exchange. In addition to having distinct purposes, the nature of mentoring relationships that are most appropriate for a particular goal, stage or progress along the roadmap can occur in many different types. Those distinct types discussed here and which can support specific mentoring purposes include formal versus informal, continuous versus episodic, and on-site versus off-site mentoring. Each of these relationship types and associated relevant literature is described in brief.

Formal versus informal. Formal mentors are often assigned to students, junior faculty, or employees based on their intake into a particular unit, department, or organization (Chao, Walz, & Gardner, 1992; Grant, 2015; Monroe, Ozyurt, Wrigley, & Alexander, 2008; Montgomery et al., 2014; Ragins & Cotton, 1999; Redmond, 1990; Wallace, Moore, & Curtis, 2014). These mentoring relationships are often dyadic and may or may not be based on identified personal factors or complementary characteristics of the mentee or mentor that could lead to a particularly productive, or alternatively avoid a nonproductive, exchange (Bass, Rutledge, Douglass, & Carter, 2007; Chao et al., 1992). By contrast, informal mentoring relationships can emerge through a senior mentor seeking out a more junior individual to offer support or guidance, or from an industrious or proactive mentee recognizing

the potential assistance or capital that may be available from an individual and the mentee initiating an engagement (Chao et al., 1992; Edmondson, 2012; Grant, 2015; Monroe et al., 2008; Ragins & Cotton, 1999). It is much more likely that informal mentoring relationships may be built based on personal factors, or perceptions thereof, that the mentee and/or mentor have that the relationship may be a “good fit.” There has been much discussion that the need to seek out informal mentoring can be critical for women or racial/ethnic minorities who may be underrepresented in particular institutions, and thus where the formal connections may not engage factors particularly relevant or of concern to the mentee (Edmondson, 2012; Monroe et al., 2008; Wallace et al., 2014). Notably, such informal mentoring may largely be an “add-on” to mentees’ established networks, including both formal and informal mentoring resources.

Continuous versus episodic. Continuous mentoring is the form that is often thought about as a default—a long-term relationship between a mentor and mentee. Continuous mentoring often occurs throughout a particular trajectory or the course of the mentee’s career. Episodic mentoring is a frequent, if under recognized, mentoring type. Episodic mentoring centers around events or isolated moments that occur once or infrequently that result in a mentoring exchange, yet do not require long-term or ongoing engagement (Long et al., 2014; Long et al., 2013). Episodic mentoring is often an effective type used to fulfill the purpose of transitional mentoring needs.

On-site (local) versus off-site (distance). Finding effective mentors that are not in the same physical location is becoming increasingly plausible (Haggard et al., 2011). The use of such “offsite” mentors has been recognized as critical for providing underrepresented minority (URM)-specific mentors for URM faculty that have limited access to such mentors at their home institutions (Zambrana et al., 2015). Off-site mentors can be engaged in conversations at a distance through technology (Ensher, Heun, & Blanchard, 2003; Grant, 2015; Guerrero-Medina et al., 2013; R. McGee, Lee, et al., 2015; Packard, 2003; Whittaker, Montgomery, & Martinez Acosta, 2015), engaged via electronic platforms (Blake-Beard et al., 2011; Ensher et al., 2003; Guerrero-Medina et al., 2013; Long et al., 2014; Wadia-Fascetti & Leventman, 2000; Whittaker & Montgomery, 2014; Whittaker et al., 2015), or at locations such as annual meetings of joint disciplinary societies (Eby, 1997; Grant, 2015; Guerrero-Medina et al., 2013; R. McGee, Lee, et al., 2015). Online mentoring can serve as a critical part of an individual’s mentoring networks; however, it has been strongly argued that off-site mentors should not replace or circumvent a need for local mentors at one’s home institution or workplace as on-site mentors often have critical input into sharing heuristic knowledge needed for successfully navigating a particular place or work environment (Whittaker & Montgomery, 2014; Whittaker et al., 2015; Zambrana et al., 2015).

Bilateral interactions. Mentoring relationships of distinct types and to fulfill defined purposes are all bilateral engagements (Byars-Winston, Branchaw, Pfund, Leverett, & Newton, 2015; Grant, 2015; Greco, 2014; Montgomery et al., 2014). Although the benefits of mentoring for mentees are often highlighted in discussions of mentoring relationships, “mentorship is a bidirectional activity” (Pietro De Camilli in Yammine, 2015), with mentors also being enriched and gaining benefits from engaging with the mentee (Chesler & Chesler, 2002; Lechuga, 2011; McKinsey, 2016). Indeed, these relationships have been described as based on “mutual benefit and mutual responsibility” (R. McGee, Lee, et al., 2015, p. 23), as well as “truth and mutual trust” (Greco, 2014, p. 3252). In addition, the bilateral nature of mentoring relationships includes “reciprocity or mutuality of social exchange” (Long et al., 2013, p. 1). This is important in contributing to the strength (or distance) of connections between an individual mentee and mentors or mentoring resources (depicted as edges in topology of mentoring networks) (Uzzi & Dunlap, 2005). As the relationships have benefits to both engaged parties, it is critical to nurture productive bilateral interactions.

Moving Ahead: Renegotiating or Ending Mentoring Relationships

Periodic review of goals. As mentoring relationships develop, it is important for both mentee and mentor to occasionally reassess their continuing goals, and indeed need, for the exchange. It is important periodically to assess whether the framework and bilateral interactions established for maintaining a specific mentee–mentor relationship still work for both parties (Grant, 2015). Such an assessment may result in the realignment of goals and mentoring activities or the identification of new goals.

Reaffirmation or renegotiation. Occasionally, a review of a current mentoring exchange may result in the realization that a particular relationship is complete or no longer serves the needs of one of the involved parties. Even as a good mentor can help you creatively and critically think your way out of a bad “station” along your path, an ill-effective mentor can sink a good opportunity, or lead you astray. Such diversions from identifying and working toward goals represent a time, energy and motivation “sink,” in which efforts are not moving the mentee forward in an individual career timeline. Periodic, intentional assessments of mentoring relationships allow recognition of whether a relationship is working well and should be reaffirmed, or whether a particular mentoring exchange has fulfilled its intended purpose or is no longer working well. This potential transition has been referred to as a “redefinition phase” in Kram’s (1983) phases of mentoring relationships. In the event that a relationship needs to be significantly renegotiated or even concluded, negotiating the way forward requires attention to fully acknowledging the

valuable contributions that have been made. It is always advisable to make the transition out of the relationship gracefully and amicably (Grant, 2015).

Mapping Your Mentoring Network

Having established a roadmap for specific educational or careers goals, either short- or long-term, the task at hand is to engage a process that allows one to progress toward building, cultivating, and sustaining a developmental mentoring network that supports personal aspirations. To establish a supportive mentoring network, it is important to identify the specific mentoring resources (i.e., nodes) that will be included in a developmental network and to initiate the appropriate relationships (i.e., edges) that will be needed to support advancement.

What or Who Are the Key Nodes?

Based on an understanding of one's individual mentoring roadmap (Figure 1), the next steps are to move toward identifying the specific mentors and mentoring resources that will comprise the nodes in a developmental mentoring network needed to support individual progress along the crafted mentoring roadmap. Identifying the types of mentoring nodes needed to support individual goals is the first step (Figure 2). Once the types of nodes needed are identified, specific individuals or resources can be sought. It is likely that at least a portion of the needed nodes will already be known or available to the mentee; thus, the first sorting is of the identified types of nodes needed into known and unknown resources (Figure 2). The next step is to search for the remaining unknown nodes. One of the first sources of information that is likely to be helpful is to query known mentors about connections to identify unknown nodes. Additional sources include conducting general searches or seeking connections through venues such as meetings, seminars, and other places that individuals who possess the expertise that you seek may be found (Figure 2). The need for both personal and professional mentors has been recognized (Eby, 1997; Grant, 2015), and should be strongly considered in the building of one's network.

What Is Their Relationship to You?

Having identified relevant nodes, promoting an understanding or visualizing the quantity or nature of the nodes, as well as the edges or ties between these nodes, is the next stage in constructing a supportive mentoring network. The degree to which one has a diverse set of nodes in one's network has been described as "network diversity" (Dobrow & Higgins, 2005; Hetty van Emmerik, 2004; Uzzi & Dunlap, 2005). The degree to which these nodes originate from different contexts or social origins is referred to as "network range" (Dobrow & Higgins, 2005). An assessment of the relationships

between the mentee and mentoring nodes may be that the relationships are characterized as either close or more distant, or as having strong or weak connections, all of which are depicted by different lengths and widths of the edges or ties connecting the nodes in the network model (Figure 3). Distance between nodes is determined by multiple factors, including emotional, professional, personal, or physical distance (Hetty van Emmerik, 2004). In addition, there may be nodes that are yet to be identified, or that are identified yet will be needed at different times based on the assessment of when a particular resource is needed. Such nodes may remain unconnected by an edge in a network at a given time point. Building stronger networks as needed occurs through initiating or strengthening connections of nodes to the mentee, and occasionally on reformulating or severing mentoring ties.

Are there relationships between nodes directly? An additional consideration is whether there may be connections between some of the mentoring nodes directly. The interconnectedness of a mentoring network can be described as "network density" (Dobrow & Higgins, p. 570). A low-density network consists of nodes that are largely independent, whereas a high-density network has nodes that have interrelationships or are well known to each other (Dobrow & Higgins, 2005; Uzzi & Dunlap, 2005). Occasionally facilitating connections between nodes or groups of nodes can enable synergistic mentoring outcomes (Uzzi & Dunlap, 2005). Such inter-network connections can also contribute to "access to a diverse array of skill sets" (Uzzi & Dunlap, 2005, p. 2). Notably, low-density networks have been associated with benefits to individuals in the early stages of exploring professional identity (Dobrow & Higgins, 2005). The degree to which network interconnectedness contributes or adds to a mentee's interaction with each mentoring node should be considered and cultivated, when helpful. Periodic assessment of relationships and current or developing needs may result in the addition or removal of nodes or movement in the position of nodes in the network.

Network Shuffle

Over the course of a goal or a career, a mentoring network has to be dynamic to accomplish maintaining the nodes and edges of the network in a topology that serves evolving career advancement needs. The management and reformation of one's network has been previously described as managing a "network shuffle" (Zambrana et al., 2015, p. 55) or network management (Uzzi & Dunlap, 2005). In the network shuffle, individuals identify a network of individuals with different, yet complementary, skills and/or resources to fulfill different mentoring needs and functions of the mentee (Long et al., 2014; Long et al., 2013; Zambrana et al., 2015). The inclusion of relevant nonhuman resources (such as books, Internet resources or courses, etc.) in networks has also been described as beneficial (Contractor, Monge, &

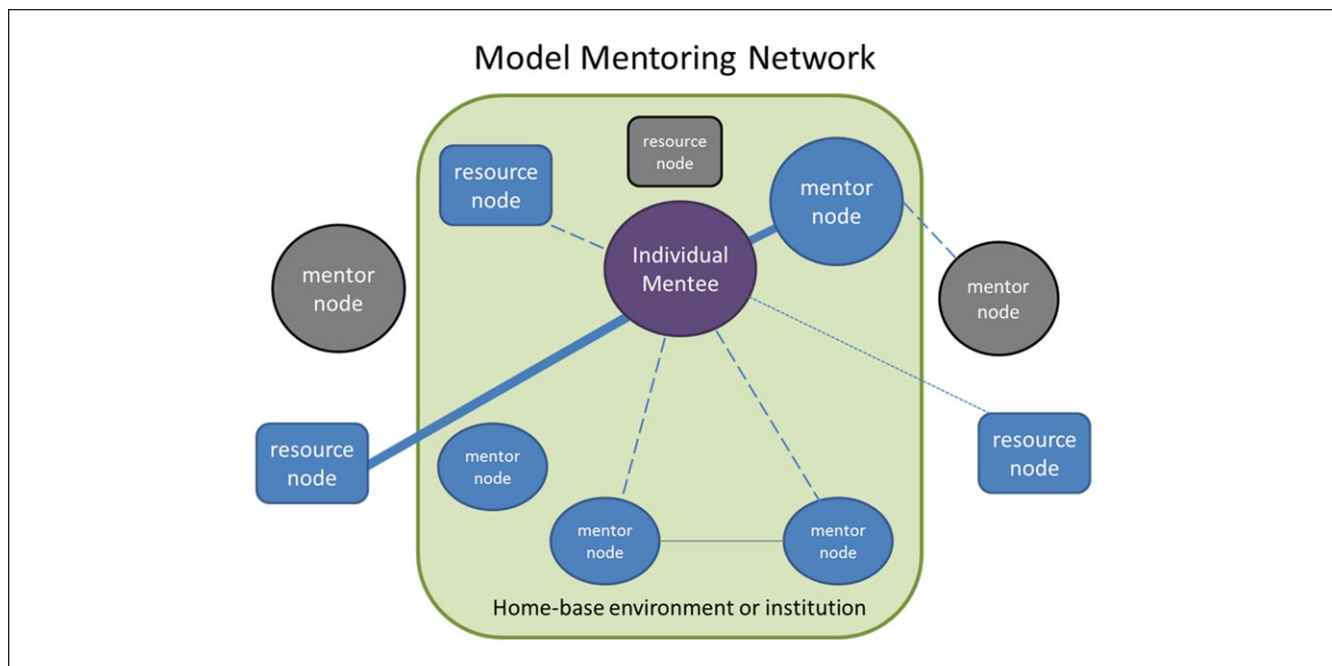


Figure 3. Mentoring network mapping model.

Note. Shown is an example of an egocentric or mentee-centered mentoring network including mentor (represented as circles) or nonhuman mentoring resources (represented as rectangles) nodes. Nonhuman resources include books, Internet resources, online courses, or other resources which provide insights into mentoring but are not direct relationships with another person. Blue nodes represent mentoring resources already known to the mentor, gray nodes are needed or unknown mentoring resources. The nodes are connected by ties or edges, which represent the relationships or interactions between mentee and mentor or engagement of mentee with a particular resource, with thinner dotted lines (weaker) to thicker solid lines (stronger) representing the strength of the relationship; and the length of the edges represent relative distance (professional, physical, or emotional). Nodes without edges are those that are identified as known nodes which will be needed at a later time or unknown or needed nodes that have not yet been identified and/or connected. The light green box represents the boundaries of the home-base environment or institution, whereas the space outside the box is external to one's home environment.

Leonardi, 2011; Long et al., 2013). Such networks are dynamic, and changes in an individual's network over time can prove beneficial to improving career or goal trajectories (Dobrow & Higgins, 2005). Indeed, a personal mentoring network should facilitate targeted, strategic, and effective movement along an individual roadmap. In this regard, a particular network model may be helpful for short-term planning, yet a different network may be more relevant or supportive for long-term planning. Thus, networks have to be evaluated periodically, particularly as related to current or short-term goals and long-term career trajectories. In this regard, Uzzi and Dunlap (2005) describe the need to periodically diagnose your network and then to reformulate and manage it to maintain a stronger supportive network in direct facilitation of individual needs, goals, and aspirations.

When and how to reposition nodes? Transitions in one's network may be critical for movement from one stage to another in one's career or course of study (Dobrow & Higgins, 2005; Grant, 2015). Mentoring has been described as effective in serving to "support in significant transitions" (Megginson et al., 2006, p. 5). This transitional mentoring (introduced above) likely will require the identification of new nodes (both in service to network diversity and network range) or

shuffling of existing nodes, closer or farther away or through facilitating interconnections (to improve network density), as the need for engagement with a particular mentor or mentoring resource changes throughout the course of advancing along an individual roadmap. A concerted effort may be needed to strengthen edges between nodes already in an individual's network or to alter the distance of edges between nodes. Also, as described above, on occasion it becomes apparent that mentoring relationships are complete and, thus, nodes may need to be removed and/or replaced altogether.

Conclusion

The need for evidence-based tools for supporting career planning, development and strategic obtaining of the mentoring required to support these efforts are clear (Poodyry, 2006; Valentine & Collins, 2015). Furthermore, there is a need for greater focus on the interpersonal processes involved in effective mentoring relationships (Hamlin & Sage, 2011). Here, career planning and reflection practices and knowledge about beneficial interpersonal exchanges are adapted to present tools helpful for supporting individual mentees in planning a mentoring roadmap and mapping a supportive, developmental mentoring network to guide individual advancement along a

personal roadmap. The tools described can also be engaged by mentors in planning for effective mentoring or facilitating co-planning or progress assessment with mentees. The partnering of the generation of a mentoring roadmap and construction of an individualized supportive mentoring network with other evidence-based tools, including participating in top-down or organizationally provided mentoring that may support understanding the framework for success in particular contexts, are anticipated to add strength to an individual's career planning and promote progressive outcomes. There are other ways in which integration of the models described here could be beneficial for a broad range of individuals from graduate students and academics to career professionals. One with great potential is integrated use of the network modeling process described here with other resources, such as an IDP (e.g., myIDP.sciencecareers.org, Clifford, 2002) for mentee self-assessment, mentoring websites (e.g., CienciaPR, www.cienciapr.org, Guerrero-Medina et al., 2013; MentorNet, <http://www.mentornet.net/>, Muller, Blake-Beard, Barsion, & Wotipka, 2012; MicroMenter, <http://www.micromenter.org/>; National Center for Faculty Development and Diversity, NCFDD, <https://facultydiversity.site-ym.com/>; National Research Mentoring Network, <https://nrmnet.net/>, R. McGee, Lee, et al., 2015), or emerging tools for mentor training (Byars-Winston et al., 2015; Pfund et al., 2014; Pfund, Maidl Pribbenow, Branchaw, Miller Lauffer, & Handelsman, 2006) and mentoring assessment (Tull, 2015). Overall, the model presented here is one integrated approach to assess a personal need for mentoring and to initiate a plan to obtain it in support of comprehensive career planning and strategic development.

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References

- Anderson, L., Silet, K., & Fleming, M. (2012). Evaluating and giving feedback to mentors: New evidence-based approaches. *Clinical and Translational Science, 5*, 71-77.
- Baker, V. L., & Griffin, K. A. (2010). Beyond mentoring and advising: Toward understanding the role of faculty "developers" in student success. *About Campus, 14*(6), 2-8.
- Bass, S. A., Rutledge, J. C., Douglass, E. B., & Carter, W. Y. (2007). *The university as mentor: Lessons learned from UMBC inclusiveness initiatives* (CGS Occasional Paper Series on Inclusiveness, Vol. 1). Washington, DC: Council of Graduate Schools.
- Blake-Beard, S., Bayne, M. L., Crosby, F. J., & Muller, C. B. (2011). Matching by race and gender in mentoring relationships: Keeping our eyes on the prize. *Journal of Social Issues, 67*, 622-643.
- Blue, D. A. (2001). Breaking the silence: Racial identity development of post-baccalaureate African American women. In R. O. Mabokela & A. L. Green (Eds.), *Sisters of the academy: Emergent Black women scholars in higher education* (pp. 117-137). Sterling, VA: Stylus Publishing.
- Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. San Francisco, CA: Jossey-Bass.
- Brown, E. E., Jr. (2011). A multicontextual model for broadening participation in STEM related disciplines. *US-China Education Review, 8*, 323-332.
- Byars-Winston, A. M., Branchaw, J., Pfund, C., Leverett, P., & Newton, J. (2015). Culturally diverse undergraduate researchers' academic outcomes and perceptions of their research mentoring relationships. *International Journal of Science Education, 37*, 2533-2554. doi:10.1080/09500693.2015.1085133
- Chao, G. T., Walz, P. M., & Gardner, P. D. (1992). Formal and informal mentorships: A comparison on mentoring functions and contrast with nonmentored counterparts. *Personnel Psychology, 45*, 619-636.
- Chesler, N. C., & Chesler, M. A. (2002). Gender-informed mentoring strategies for women engineering scholars: On establishing a caring community. *Journal of Engineering Education, 91*, 49-55.
- Clifford, P. S. (2002, September 30). Quality time with your mentor. *The Scientist, 16*(19), 59.
- Contractor, N., Monge, P., & Leonardi, P. M. (2011). Multidimensional networks and the dynamics of sociomateriality: Bringing technology inside the network. *International Journal of Communication, 5*, 682-720.
- Cunningham, J. B. (1993). Facilitating a mentorship programme. *Leadership & Organization Development Journal, 14*(4), 15-20.
- Davidson, M. N., & Foster-Johnson, L. (2001). Mentoring in the preparation of graduate researchers of color. *Review of Educational Research, 71*, 549-574. doi:10.3102/00346543071004549
- de Janasz, S. C., & Sullivan, S. E. (2004). Multiple mentoring in academe: Developing the professorial network. *Journal of Vocational Behavior, 64*, 263-283. doi:10.1016/j.jvb.2002.07.001
- Dobrow, S. R., & Higgins, M. C. (2005). Developmental networks and professional identity: A longitudinal study. *Career Development International, 10*, 567-583. doi:10.1108/13620430510620629
- Dodson, J. E., Montgomery, B. L., & Brown, L. J. (2009). "Take the fifth": Mentoring students whose cultural communities were not historically structured into U.S. higher education. *Innovative Higher Education, 34*, 185-199.
- Driscoll, L. G., Parkes, K. A., Tilley-Lubbs, G. A., Brill, J. M., & Pitts Bannister, V. R. (2009). Navigating the lonely sea: Peer mentoring and collaboration among aspiring women scholars. *Mentoring & Tutoring: Partnership in Learning, 17*, 5-21.
- Eby, L. T. (1997). Alternative forms of mentoring in changing organizational environments: A conceptual extension of the mentoring literature. *Journal of Vocational Behavior, 51*, 125-144. doi:10.1006/jvbe.1997.1594
- Edmondson, V. C. (2012). Reflections from a Black female in the promotion and tenure process. *Gender in Management, 27*, 331-345.
- Ensher, E. A., Heun, C., & Blanchard, A. (2003). Online mentoring and computer-mediated communication: New directions in research. *Journal of Vocational Behavior, 63*, 264-288.

- Ensher, E. A., Thomas, C., & Murphy, S. E. (2001). Comparison of traditional, step-ahead, and peer mentoring on protégés' support, satisfaction, and perceptions of career success: A social exchange perspective. *Journal of Business and Psychology, 15*, 419-438.
- Faber, Z. [DrFaber]. (2015, October 25). IDPs are a very useful tool, but need buy in from both sides. Value is in the conversation, not compliance with policy [Tweet]. Retrieved from <https://twitter.com/DrFaber/status/657311949340979202>
- Gibau, G. S., Foertsch, J., Blum, J., Brutkiewicz, R., Queener, S., Roman, A., . . . Broxmeyer, H. (2010). Diversifying biomedical training: A synergistic intervention. *Journal of Women and Minorities in Science and Engineering, 16*, 215-235.
- Grant, C. S. (2015). Mentoring: Empowering your success. In P. A. Pritchard & C. S. Grant (Eds.), *Success strategies from women in STEM: A portable mentor* (pp. 63-96). Waltham, MA: Elsevier.
- Greco, V. (2014). Establishing an academic laboratory: Mentoring as a business model. *Molecular Biology of the Cell, 25*, 3251-3253. doi:10.1091/mbc.E14-06-1079
- Griffin, K. A., & Toldson, I. A. (2012). Reflections on mentoring for blacks in academia (Editor's Commentary). *The Journal of Negro Education, 81*, 103-105.
- Guerrero-Medina, G., Feliú-Mójer, M., González-Espada, W., Díaz-Muñoz, G., López, M., Díaz-Muñoz, S. L., . . . Colón-Ramos, D. A. (2013). Supporting diversity in science through social networking. *PLoS Biology, 11*(12), e1001740. doi:10.1371/journal.pbio.1001740
- Haggard, D. L., Dougherty, T. W., Turban, D. B., & Wilbanks, J. E. (2011). Who is a mentor? A review of evolving definitions and implications for research. *Journal of Management, 37*, 280-304. doi:10.1177/0149206310386227
- Hamlin, R. G., & Sage, L. (2011). Behavioural criteria of perceived mentoring effectiveness: An empirical study of effective and ineffective mentor and mentee behaviour within formal mentoring relationships. *Journal of European Industrial Training, 35*, 752-778.
- Hetty van Emmerik, I. J. (2004). The more you can get the better: Mentoring constellations and intrinsic career success. *Career Development International, 9*, 578-594.
- Higgins, M. C., & Kram, K. E. (2001). Reconceptualizing mentoring at work: A developmental network perspective. *Academy of Management Review, 26*, 264-288.
- Higgins, M. C., & Thomas, D. A. (2001). Constellations and careers: Toward understanding the effects of multiple developmental relationships. *Journal of Organizational Behavior, 22*, 223-247.
- Jacobi, M. (1991). Mentoring and undergraduate academic success: A literature review. *Review of Educational Research, 61*, 505-532.
- Kirchmeyer, C. (2005). The effects of mentoring on academic careers over time: Testing performance and political perspectives. *Human Relations, 58*, 637-660.
- Kram, K. E. (1983). Phases of the mentor relationship. *Academy of Management Journal, 26*, 608-625.
- Kram, K. E. (1985). *Mentoring at work: Developmental relationships in organizational life*. Glenview, IL: Scott, Foresman.
- Kroll, J. (2016). What is meant by the term group mentoring? *Mentoring & Tutoring: Partnership in Learning, 24*, 44-58.
- Lechuga, V. (2011). Faculty-graduate student mentoring relationships: Mentors' perceived roles and responsibilities. *Higher Education, 62*, 757-771. doi:10.1007/s10734-011-9416-0
- Lewis, C., & Olshansky, E. (2016). Relational-cultural theory as a framework for mentoring in academia: Toward diversity and growth-fostering collaborative scholarly relationships. *Mentoring & Tutoring: Partnership in Learning, 24*, 383-398.
- Long, Z., Buzzanell, P. M., Anderson, L. B., Batra, J. C., Kokini, K., & Wilson, R. F. (2014). Episodic, network, and intersectional perspectives: Taking a communicative stance on mentoring in the workplace. In E. L. Cohen (Ed.), *Communication yearbook 38* (pp. 387-422). New York, NY: Routledge.
- Long, Z., Buzzanell, P. M., Kokini, K., Wilson, R. F., Batra, J. C., & Anderson, L. B. (2013, June 23-26). *Exploring women engineering faculty's mentoring networks*. Paper presented at the 120th ASEE Annual Conference and Exposition, Atlanta, GA.
- Malone, K. R., & Barabino, G. (2009). Narrations of race in STEM research settings: Identity formation and its discontents. *Science Education, 93*, 485-510.
- McGee, E. O., Robinson, W. H., Bentley, L. C., & Houston, I. I. S. (2015, June 14-17). *Diversity stalled: Explorations into the stagnant numbers of African American engineering faculty*. Paper presented at the 122nd ASEE Annual Conference & Exposition, Seattle, WA.
- McGee, R., Lee, S., Pfund, C., & Branchaw, J. (2015). Beyond "finding good mentors" to "building and cultivating your mentoring team." In B. L. Huang (Ed.), *Advancing postdoc women guidebook* (pp. 23-33). Washington, DC: National Postdoctoral Association.
- McGee, R., Jr., Saran, S., & Krulwich, T. A. (2012). Diversity in the biomedical research workforce: Developing talent. *Mount Sinai Journal of Medicine, 79*, 397-411.
- McKinsey, E. (2016). Faculty mentoring undergraduates: The nature, development, and benefits of mentoring relationships. *Teaching & Learning Inquiry, 4*(1), 1-15.
- Meggison, D., Clutterback, D., Garvey, B., Stokes, P., & Garrett-Harris, R. (2006). *Mentoring in action: A practical guide for managers* (2nd ed.). Great Britain, UK: Kogan Page.
- Monroe, K., Ozyurt, S., Wrigley, T., & Alexander, A. (2008). Gender equality in academia: Bad news from the trenches, and some possible solutions. *Perspectives on Politics, 6*, 215-233.
- Montgomery, B. L. [BerondaM]. (2015a, October 7). Advisors tell any person what is needed to complete a task/degree, mentors "learn" you & speak to your unique needs [Tweet]. Retrieved from <https://twitter.com/BerondaM/status/651900464016039937>
- Montgomery, B. L. [BerondaM]. (2015b, October 10). Impactful mentoring should be about personal growth rather than solely about personal advancement. Focus on growth...advancing will follow [Tweet]. Retrieved from <https://twitter.com/BerondaM/status/652854645484843008>
- Montgomery, B. L., Dodson, J. E., & Johnson, S. M. (2014). Guiding the way: Mentoring graduate students and junior faculty for sustainable academic careers. *SAGE Open, 4*(4). doi:10.1177/2158244014558043
- Muller, C., Blake-Beard, S., Barsion, S. J., & Wotipka, C. M. (2012). Learning from the experiences of women of color in MENTORNET's one-on-one program. *Journal of Women and Minorities in Science and Engineering, 18*, 315-335.
- Packard, B. W. (2003). Web-based mentoring: Challenging traditional models to increase women's access. *Mentoring & Tutoring: Partnership in Learning, 11*, 53-65.
- Packard, B. W. (2016). *Successful STEM mentoring initiatives for underrepresented students: A research-based guide for faculty and administrators*. Sterling, VA: Stylus Publishing.

- Packard, B. W., Kim, G. J., Sicley, M., & Pionkowski, S. (2009). Composition matters: Multi-context informal mentoring networks for low-income urban adolescent girls pursuing health-care careers. *Mentoring & Tutoring: Partnership in Learning, 17*, 187-200.
- Pfund, C., House, S. C., Asquith, P., Fleming, M. F., Buhr, K. A., Burnham, E. L., . . . Schurr, K. (2014). Training mentors of clinical and translational research scholars: A randomized controlled trial. *Academic Medicine, 89*, 774-782.
- Pfund, C., Maidl Pribbenow, C., Branchaw, J., Miller Lauffer, S., & Handelsman, J. (2006). The merits of training mentors. *Science, 311*, 473-474. doi:10.1126/science.1123806
- Poodry, C. A. (2006). The scientific approach. *The Scientist, 20*, 8-9.
- Ragins, B. R., & Cotton, J. L. (1999). Mentor functions and outcomes: A comparison of men and women in formal and informal mentoring relationships. *Journal of Applied Psychology, 84*, 529-550.
- Ramirez, J. J. (2012). The intentional mentor: Effective mentorship of undergraduate science students. *Journal of Undergraduate Neuroscience Education, 11*(1), A55-A63.
- Redmond, S. P. (1990). Mentoring and cultural diversity in academic settings. *American Behavioral Scientist, 34*, 188-200.
- Rockquemore, K. A. (2013, July 22). A new model of mentoring. *Inside Higher Ed*. Retrieved from <https://www.insidehighered.com/advice/2013/07/22/essay-calling-senior-faculty-embrace-new-style-mentoring>
- Smith, J. L., Cech, E., Metz, A., Huntoon, M., & Moyer, C. (2014). Giving back or giving up: Native American student experiences in science and engineering. *Cultural Diversity & Ethnic Minority Psychology, 20*, 413-429. doi:10.1037/a0036945
- Sorcinelli, M. D., & Yun, J. (2007). From mentor to mentoring networks: Mentoring in the new academy. *Change: The Magazine of Higher Learning, 39*(6), 58-61.
- Sorcinelli, M. D., & Yun, J. (2009). Thriving in academe: Finding a mentor. *NEA Higher Education Advocate, 26*(5), 5-8.
- Stassun, K. G., Burger, A., & Lange, S. E. (2010). The Fisk-Vanderbilt Masters-to-PhD bridge program: A model for broadening participation of underrepresented groups in the physical sciences through effective partnerships with minority-serving institutions. *Journal of Geoscience Education, 58*, 135-144.
- Stassun, K. G., Sturm, S., Holley-Bockelmann, K., Burger, A., Ernst, D. J., & Webb, D. (2011). The Fisk-Vanderbilt Master's-to-PhD bridge program: Recognizing, enlisting, and cultivating unrealized or unrecognized potential in underrepresented minority students. *American Journal of Physics, 79*, 374-379. doi:10.1119/1.3546069
- Trube, M. B., & VanDerveer, B. (2015). Support for engaged scholars: The role of mentoring networks with diverse faculty. *Mentoring & Tutoring: Partnership in Learning, 23*, 311-327. doi:10.1080/13611267.2015.1099869
- Tull, R. G. (2015, November 6). *The mentor mirror: A reverse individual development plan for mentors*. Paper presented at the 2015 SREB Institute for Teaching and Mentoring/Compact for Faculty Diversity, Arlington, VA.
- Tull, R. G., & Tull, D. L. (2012, September). A formula for success. *Optics & Photonics News*, pp. 14-16.
- Uzzi, B., & Dunlap, S. (2005, December). How to build your network. *Harvard Business Review*. Retrieved from <https://hbr.org/2005/12/how-to-build-your-network>
- Valantine, H. A., & Collins, F. S. (2015). National Institutes of Health addresses the science of diversity. *Proceedings of the National Academy of Sciences of the United States of America, 112*, 12240-12242.
- Varkey, P., Jatoti, A., Williams, A., Mayer, A., Ko, M., Files, J., . . . Hayes, S. (2012). The positive impact of a facilitated peer mentoring program on academic skills of women faculty. *BMC Medical Education, 12*, Article 14.
- Vincent, B. J., Scholes, C., Staller, M. V., Wunderlich, Z., Estrada, J., Park, J., . . . DePace, A. H. (2015). Yearly planning meetings: Individualized development plans aren't just more paperwork. *Molecular Cell, 58*, 718-721.
- Wadia-Fascetti, S., & Leventman, P. G. (2000). E-mentoring: A longitudinal approach to mentoring relationships for women pursuing technical careers. *Journal of Engineering Education, 89*, 295-300.
- Wallace, S. L., Moore, S. F., & Curtis, C. M. (2014). Black women as scholars and social agents: Standing in the gap. *Negro Educational Review, 65*, 44-62.
- Washington, R., & Cox, E. (2016). How an evolution view of workplace mentoring relationships helps avoid negative experiences: The developmental relationship mentoring model in action. *Mentoring & Tutoring: Partnership in Learning, 24*, 318-340.
- Whittaker, J. A., & Montgomery, B. L. (2012). Cultivating diversity and competency in STEM: Challenges and remedies for removing virtual barriers to constructing diverse higher education communities of success. *Journal of Undergraduate Neuroscience Education, 11*(1), A44-A51.
- Whittaker, J. A., & Montgomery, B. L. (2014). Cultivating institutional transformation and sustainable STEM diversity in higher education through integrative faculty development. *Innovative Higher Education, 39*, 263-275.
- Whittaker, J. A., Montgomery, B. L., & Martinez Acosta, V. G. (2015). Retention of underrepresented minority faculty: Strategic initiatives for institutional value proposition based on perspectives from a range of academic institutions. *Journal of Undergraduate Neuroscience Education, 13*(3), A136-A145.
- Williams, J. E., Wake, C., Hayden, L., Abrams, E., Hurtt, G., Rock, B., . . . Johnson, D. (2011). Building a model of collaboration between Historically Black and Historically White Universities. *Journal of Higher Education Outreach & Engagement, 15*(2), 35-55.
- Wilson, Z. S., Holmes, L., deGravelles, K., Sylvain, M. R., Batiste, L., Johnson, M., . . . Warner, I. M. (2012). Hierarchical mentoring: A transformative strategy for improving diversity and retention in undergraduate STEM disciplines. *Journal of Science Education and Technology, 21*, 148-156.
- Yamine, S. [samanthazy]. (2015, October 17). "Mentorship is a bidirectional activity, we learn a lot from trainees" - Pietro de Camille [sic], winner of Julius Axelrod award at #SfN15 [Tweet]. Retrieved from <https://twitter.com/samanthazy/status/655511740772388864>

- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education*, 8, 69-91.
- Yun, J., & Sorcinelli, M. D. (2009). When mentoring is the medium: Lessons learned from a faculty development initiative. *To Improve the Academy*, 27, 365-384.
- Zambrana, R. E., Ray, R., Espino, M. M., Castro, C., Douthirt Cohen, B., & Eliason, J. (2015). "Don't leave us behind": The importance of mentoring for underrepresented minority faculty. *American Educational Research Journal*, 52, 40-72. doi:10.3102/0002831214563063

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