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Mentor qualities that matter: The importance of perceived (not demographic) similarity

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Abstract

Mentoring, particularly same-gender and same-race mentoring, is increasingly seen as a powerful method to attract and retain more women and racial minorities into science, technology, engineering, and mathematics (STEM) education and careers. This study examines elements of a mentoring dyad relationship (i.e., demographic and perceived similarity) that influence the quality of mentorship, as well as the effect of mentorship on STEM career commitment. A national sample of African American undergraduates majoring in STEM disciplines were surveyed in their senior year. Overall, perceived similarity, rather than demographic similarity, was the most important factor associated with protégé perceptions of high quality mentorship and high quality mentoring was in turn associated with higher commitment to STEM careers. We discuss the implications for mentoring underrepresented students and broadening participation in STEM.

Keywords

Mentoring; college students; higher education; minorities; STEM; perceived similarity; career commitment

Introduction and purpose

The U.S. needs to attract and retain more women and racial minorities into science, technology, engineering, and mathematics (STEM) careers in order to meet market demand and remain internationally competitive. According to a recent National Academies report, maintaining and expanding economic prosperity through the education and training of a

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globally competitive workforce in STEM disciplines is a national priority (National Academies Committee on Prospering in the Global Economy of the 21st Century, National Academies Committee on Science, Engineering, & Public Policy, 2007). National Academies reports have called for substantial efforts to increase the proportion of undergraduates who earn a baccalaureate degree in a STEM discipline, and acknowledged the need to achieve national goals by increasing the participation and persistence of talented individuals from underrepresented groups (i.e., women and racial minorities) in STEM majors (National Academies Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, National Academies Committee on Science, Engineering, & Public Policy and Global Affairs, 2011). The current research explores the extent to which faculty mentoring (and which elements of the mentoring relationship) may be critical to retaining talented individuals from diverse groups in STEM disciplines.

The chronic underrepresentation of women and racial minorities in STEM disciplines is not due to lack of interest at entry into college (Hurtado et al., 2011), but rather, is due to higher attrition: switching to non-STEM majors and/or college dropout (Chen & Soldner, 2013). For over thirty years a large number of public and private agencies have prioritized funding interventions that support the recruitment and persistence of underrepresented minorities (URMs) in STEM disciplines (Alper, 1993; Author et al., 2015; Graham, Frederick, Byars-Winston, Hunter, & Handelsman, 2013). A number of interventions appear to hold promise for improving the representation and persistence of minorities in STEM and faculty-student mentoring has typically been described as a part of a successful intervention strategy (Author et al., 2015; Collea, 1990; Maton & Hrabowski, 2004). However, studies investigating the unique beneficial effects of mentoring on student satisfaction, educational performance, career development, and persistence in STEM disciplines have not found consistent positive results (Author et al., 2011a; Blake-Beard, Bayne, Crosby, & Muller, 2011; Campbell & Campbell, 1997; Phinney, Campos, Kallemeyn, & Kim, 2011; Tenenbaum, Crosby, & Gliner, 2001). Therefore, the current study examined the conditions under which mentoring had the most beneficial effects on student outcomes (e.g., intention to persist in STEM career) in a national sample of mentored African American students in STEM majors.

Mentoring in academia

Consistent with prior research in workplace and academic settings, we adopted a definition of mentorship as a developmental relationship between a more experienced individual (mentor) and a less experienced individual (protégé), wherein the mentor provides support to the protégé with the aim of enhancing their personal development and integration or socialization into a profession (Crisp & Cruz, 2009; Eby, Rhodes, & Allen, 2007; Jacobi, 1991; Kram, 1985). Although much of the empirical research among undergraduates assumes that the mentoring relationship are informal, some are likely to be formal in nature (Eby et al., 2007; Eby et al., 2013). Formal mentoring refers to situations wherein the relationship is facilitated or initiated, managed, and sanctioned by a third party (Chao, Walz, & Gardner, 1992); whereas, informal mentoring refers to situations wherein the relationship is initiated spontaneously (e.g., the mentor may seek out the protégé; Eby et al., 2007). For

example, a student may reach out to a favored professor outside of class for mentorship in the form of career advice, opportunities to engage in research, or guidance on an honors thesis.

Regardless of how the mentoring relationship was initiated, the long educational process of developing new scientists has been described as one involving social influence (Author et al., 2011b). In this framework, mentors act as socializing or influence agents, drawing the protégés into the profession by providing support and by encouraging the protégés to internalize the norms, behaviors, and values of the scientific community (Author et al., 2015; Bauer & Green, 1994; Davis, 2008; Kardash & Edwards, 2012). Mentoring programs for undergraduates in STEM disciplines often adopt a graduate school style apprenticeship model of research and training to draw talented students into the profession (Chemers et al., 2011; Hurtado et al., 2011; Kardash & Edwards, 2012; Maton & Hrabowski, 2004; Wilson et al., 2011). In practice, the mentoring or apprenticing often involves academic advising or counseling, regular meetings (planned or spontaneous) outside of the classroom, involvement in faculty-guided undergraduate researcher experiences (UREs), engagement with a local research community of practice (e.g., peers, graduate students, and/or post-doctoral fellows in the faculty mentor's research lab), and opportunities to engage with the broader community through research dissemination (e.g., academic conferences) and professional involvement (e.g., colloquium, seminars, or social events; Author et al., 2011; Crisp & Cruz, 2009; Eby et al., 2007; Kardash & Edwards, 2012; Maton & Hrabowski, 2004). However, Crisp and Cruz (2009) noted that studies of undergraduate mentoring or mentoring programs have tended to focus on relatively small and narrow samples, which has made it difficult to capture systematic variability in mentoring practices across disciplines. The current study adds to the literature by reporting on the mentoring experiences of a large sample of undergraduates in a variety of STEM disciplines.

Research in academic settings indicates that faculty mentors provide support along (at least) three dimensions (or functions): psycho-social support, instrumental support, and coauthoring experiences (Jacobi, 1991; Paglis, Green, & Bauer, 2006). *Psycho-social* support consists of activities such as counseling, encouragement, and role modeling (Eby et al., 2013). *Instrumental* support consists of activities such as assistance on challenging tasks, coaching, and providing opportunities for advancement (Eby et al., 2013). The third mentor support function, *coauthoring experience*, is unique to academic mentoring and includes collaborative presentations and the publication of research (Paglis et al., 2006).

Recent advancements in mentoring theory indicate that protégé perceptions of the quality of the mentor-protégé relationship, in terms of the protégé's overall satisfaction and trust (hereafter referred to as the protégé's *relationship satisfaction*), is both an outcome of mentor support and a predictor of more distal career outcomes, see Figure 1 (Eby et al., 2013; Rhoades, 2005). More specifically, research indicates that the protégé's relationship satisfaction is a necessary relational factor for enhancing the protégé's socialization into a profession (e.g., increasing science efficacy/competence, science identity, positive behaviors, & career outcomes; Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011; Eby et al., 2013; Paglis et al., 2006). A recent inter-disciplinary (i.e., academic, workplace, & youth) synthesis of the mentoring literature summarized 173 primary studies and found small-to-

moderate associations between the protégé's perceptions of psycho-social support, instrumental support, relationship satisfaction, and successful socialization outcomes, such as learning and perceived career success (Eby et al., 2013). In addition, the synthesis found some evidence in support for the hypothesis that protégé perceptions of mentor support functions influence career outcomes through the protégé's relationship satisfaction. However, close scrutiny of the synthesis findings revealed that only a small proportion of the evidence linking mentoring support functions and relationship satisfaction to outcomes came from studies in academic settings (i.e., $\overline{k}$ = 1.18, range = 0–5). A lingering question concerns the extent to which the findings from workplace settings generalize to STEM disciplines within academic settings. This study serves to extend workplace mentoring research to academic mentoring in STEM disciplines.

Mentor support in academic contexts in the form of coauthoring experience serves a unique role in the successful socialization of protégés into STEM careers. Research on mentored graduate students in STEM disciplines has indicated that coauthoring experience was directly related to academic productivity and indirectly related to career commitment (Chemers et al., 2011; Paglis et al., 2006). However, there is little evidence directly linking coauthoring experience to career outcomes at the undergraduate level (Chemers et al., 2011). Therefore, a key question concerns the extent to which findings from graduate school STEM contexts generalize to undergraduate STEM contexts.

Similarity and mentoring support

A large number of precursors or antecedent factors (e.g., protégé demographics, mentor-protégé demographic similarity, perceived similarity, and amount of mentor-protégé contact) have been theorized to influence mentor support functions (e.g., psycho-social support) and the protégé's relationship satisfaction (hereafter the combination of mentor support and relationship satisfaction will be referred to as *quality mentorship*). For example, theory and evidence indicate that protégé gender may influence the quality of mentoring received; however, much of the evidence comes from studies of workplace mentoring, not mentoring of undergraduate students. More important for the current study, based largely on the similarity attraction paradigm, the demographic similarity (also called surface similarity) of the mentor and protégé has long been hypothesized to influence the quality of mentorship (Blake-Beard et al., 2011; Harrison, Price, & Bell, 1998; Ragins, 1997; Turban, Dougherty, & Lee, 2002). Researchers have theorized that gender or racial matching would be advantageous because demographic shared similarities might provide the protégé with a more salient role model, as well as with mentors that could more easily empathize and provide interpersonal comfort and emotional support. However, recent theoretical and empirical developments indicate that the amount of mentor-protégé contact (often operationalized as interaction frequency or relationship duration) is an important moderator of the relationship between demographic similarity and the quality of mentorship (Ensher & Murphy, 1997; Harrison et al., 1998).

Mentor-protégé contact has been an important feature of mentoring theory for decades. For example, Kram (1985) proposed that mentoring relationships consisted of four distinct phases (initiation, cultivation, separation, and redefinition) that develop over time. Kram

(1985) also proposed that important aspects of the mentoring relationship change as the relationship transitions from one phase to the next. Although few studies have empirically examined Kram's developmental phases or transitions between them (cf. Turban et al., 2002), recent studies have examined the role of contact in the mentoring relationship. According to theory, protégés gain more benefits from their mentor when they have more frequent interactions and/or when the relationship endures over longer periods of time (Eby et al., 2013). Empirical research supports the positive relationship contact and the quality of mentorship (de Janasz & Godshalk, 2013; Lankau, Riordan, & Thomas, 2005). In addition to being a correlate, contact appears to moderate the relationship between mentor-protégé similarities and the quality of mentorship. Specifically, early in the mentoring relationship when the dyad have had little contact, gender and racial similarity are hypothesized to promote higher quality of mentorship based on the rationale given above (e.g., role modeling, empathy, etc.). However, when the dyad have had higher levels of contact, the effect of demographic similarity on the quality of mentorship is expected to wane and be replaced by psychological similarities (e.g., shared attitudes and/or shared values; Turban et al., 2002). Evidence from mostly White and mostly female samples in academic settings supports a small positive association between gender similarity and the quality of mentorship, particularly early in the relationship (e.g., gender homogeneous dyads exhibit slightly higher psycho-social support; Blake-Beard et al., 2011; Turban et al., 2002). Similarly, evidence from corporate settings indicates that mentor-protégé contact moderates the effect of demographic similarity on the quality of mentorship (Allen & Eby, 2003; Ensher & Murphy, 1997). A synthesis of the mentoring literature found weak or negligible support for a link between demographic similarity and the quality of mentorship (Eby et al., 2013). But, as noted above, few of the primary studies in the synthesis focused on minority students in STEM academic contexts, and fewer still made a distinction between mentoring dyads with more or less contact.

Perceived similarity (also called deep-level similarity) considers mentor-protégé similarities in terms of shared attitudes, beliefs, outlook, and values (Harrison et al., 1998). According to theory, perceived similarities (e.g., attitudes or values) are important factors in the development of attraction, liking, friendship, and ultimately, the quality of mentorship (Ensher & Murphy, 1997; Harrison et al., 1998). Although a convergence of data show the importance of perceived similarity on the quality of the mentoring relationship (Eby et al., 2013), little research within the mentoring literature has shed light on the factors that engender high levels of perceived similarity. However, experimental and correlational research in the social influences literature indicates that diverse types of similarities (e.g., name, physical, musical, hobbies, or values) can engender higher perceptions of similarity and even trivial similarities can have a positive impact on the quality of the relationship (Boer, Fischer, Strack, Bond, Lo, & Lam, 2011; Gamer, 2005; Gehlbach, Brinkworth, King, Hsu, McIntyre, & Rogers, 2016; MacKinnon, Jordan, & Wilson, 2011). For example, a recent randomized field study with 9th graders manipulated the disclosure of five shared similarities between students and teachers on a wide variety of topics (e.g., similar choice in field trip location [museum, sports event, music concert, or hiking]; Gehlbach et al., 2016). Student who received the list of five shared similarities had significantly higher levels of perceived similarity five weeks after the brief intervention and exhibited better performance

on educational outcomes at the end of the term. A similar process may be involved in engendering protégé's perceptions of similarity at the undergraduate level.

Research in the mentoring literature shows a positive relationship between perceived similarity and the quality of the mentoring; however, as with demographic similarity, mentor-protégé contact has been hypothesized to moderate the relationship (Harrison et al., 1998). Specifically, early in the mentoring relationship when the dyad have had little contact, the mentor and protégé know little about the degree to which they share similar attitudes, beliefs, or values. Therefore, perceived similarity has been proposed to have limited influence on the quality of mentorship early in the mentoring relationship. However, when the dyad have had higher levels of contact, they are expected to discover the degree to which they share similar attitudes and values (Harrison et al., 1998). Evidence from workplace and academic settings have found moderate-to-strong relationships between perceived similarity and the quality of mentorship (Eby et al., 2013). However, as with demographic similarity, relatively few studies in this literature have focused on minorities in STEM academic contexts.

Current study

The purpose of the current study was to investigate the effect of demographic (i.e., gender and race) and perceived similarities on undergraduate URM protégé perceptions of the quality of mentorship (i.e., psycho-social support, instrumental support, coauthoring experiences, and relationship satisfaction), as well as the effect of high quality mentorship on STEM career commitment. Investigations of the benefits of gender- or race-matched mentoring relationships have not produced consistent results across the mentoring literature, particularly in the undergraduate and STEM focused career development mentoring literature. And investigations of the benefits of perceived similarity have largely been conducted in non-academic contexts. Furthermore, much of the extant mentoring research with undergraduates has focused on "at risk" URMs regardless of major (Phinney et al., 2011) or on White female college students in STEM majors (Blake-Beard et al., 2011). Prior studies do not provide sufficient insight into academic mentoring of high achieving URM STEM students. Unlike previous research, the current study focuses on the mentoring experiences of undergraduate URMs in STEM disciplines during their senior year in college. We focus on the senior year in college, as it is a critical transition point where students make decisions to pursue (or not pursue) the advanced training required to achieve a research oriented STEM career. Based on the literature, we proposed the following hypotheses.

H_1: Demographic Similarity × Contact: When mentor-protégé contact is relatively low, protégés in demographically (race or gender) homogeneous dyads will perceive having higher quality mentorship compared to protégé in demographically heterogeneous dyads. For example, when the frequency of interactions between the mentor and protégé is low, we would expect that female student protégés paired with a female faculty mentor will receive higher levels of mentoring support than female student protégés paired with a male faculty mentor. However, this effect will diminish with higher levels of contact.

H_2: Perceived Similarity × Contact: When mentor-protégé contact is relatively high, protégé perceptions of similarity will be positively associated with protégé perceptions of the quality of mentorship. For example, when the frequency of interactions between the mentor and protégé is high, we would expect that students that see themselves as highly similar to their faculty mentor would receive high levels of mentoring support. However, this effect will be negligible when contact is low.

H_3. Protégé perceptions of psycho-social support, instrumental support, and coauthoring experiences will positively predict the protégé's relationship satisfaction. For example, students that receive higher levels of psycho-social support, instrumental support, and have opportunities to co-author with their faculty mentors will have high levels of satisfaction with the mentoring relationship.

H_4. Protégé perceptions of psycho-social support, instrumental support, coauthoring experiences, and relationship satisfaction will positively predict STEM career commitment. For example, students that have high levels of mentoring support and satisfaction will report high levels of intentions to pursue a scientific career.

Methods

Participants and Procedure

We report on a sample of high achieving African American undergraduates majoring in STEM disciplines (Author et al., 2011a). Participants were drawn from our national longitudinal quasi-experimental study of 1,420 URM students majoring in biomedical-related STEM disciplines from universities across the United State. Students were recruited from 50 four-year institutions, 25 with NIH-funded Research Initiative for Scientific Enhancement (RISE) programs and 25 matched campuses. The sampling strategy for the national longitudinal study involved purposeful recruitment of students funded by minority science training programs (e.g., RISE and others) as well as recruitment of a matched sample of unfunded minority science students from upper-division gateway science courses (Author et al., 2011). Since fall 2005, participants have responded to bi-annual online surveys concerning their educational and career pursuits (e.g., majoring in Biology, enrollment in a Ph.D. program in Cell Biology), experiences (e.g., mentoring and research activities), aspirations (e.g., intention to pursue a scientific research career), achievements (e.g., research conference presentations), and a number of theoretically relevant psychological factors (e.g., scientific self-efficacy). Participants received a small incentive in advance of their participation in the study each measurement occasion (Author et al., 2011a, 2014). Response rates for surveys have ranged from 70% to 92% over time (Author et al., 2014).

In the current study, we focused on the mentoring experiences of native English speaking African American undergraduates (N = 582) from 33 universities in the spring semester of their senior year. The spring semester of senior year was chosen because it represents a

critical transition point during which students make decisions about the pursuit of higher education and career goals.

Of the larger sample of African American undergraduates, we selected only those that reported having a faculty mentor ($N = 253$; hereafter called protégés). Regarding demographic and background characteristics of this analytic sample, most were female (80%), most were in their early twenties ($M = 21.07$, $SD = 3.01$), and 12% were first generation attending college. Regarding academic choices and characteristics, when initially recruited into the study 11% had transferred to their current 4-year institution from a 2-year institution and most were majoring in a biological (59%) or natural (e.g., physics; 28%) science, with a smaller proportion in a social/behavioral science (10%) or a technology or engineering or mathematics major (3%). A comparison of protégés with a mentor ($n = 253$), without a mentor ($n = 125$), and those missing data in the spring of their senior year ($n = 204$) showed that the subgroups were not statistically significantly different in terms of any initial demographic (gender, age), background (parental highest level of education), or academic characteristics (transfer student, field of study). All further analyses were conducted on the sample of protégés with a mentor.

Measures

Having a mentor—To assess if the students currently had a faculty mentor, they were instructed to think of a mentor as someone who provides guidance, assistance, and encouragement on professional and academic issues. With that definition in mind, students were asked to respond “Yes” or “No” to the following question: “Is there a faculty member that you would consider a mentor?” Only students who responded “Yes” to the faculty mentor question were asked the following questions about mentor demographics, similarity, contact, and mentorship quality.

Mentor demographics and mentor-protégé demographics similarity—Protégés were asked about their mentors’ gender (female = 49%, male = 51%) and race/ethnicity (African-American/Black = 55%, Asian = 6%, Hawaiian/Pacific Islander < 1%, Hispanic/Latino/Latina = 3%, Native American/Alaskan Native < 1%, White – non-Hispanic = 25%, Unsure = 5%, & Other = 6%). Responses were transformed into effect coded indicators of mentor gender (e.g., female mentor = −.50, male mentor = .50), mentor race/ethnicity, mentor-protégé gender similarity (hereafter referred to as gender homogeneity = 58%), and mentor-protégé racial/ethnic similarity (hereafter referred to as racial homogeneity = 55%). Because our entire sample consisted of African-American undergraduate protégés, the mentor race/ethnicity and dyad racial homogeneity variables were linearly dependent, so of the two only the racial homogeneity variable was used in our analyses.

Perceived similarity—Protégés were asked to assess the degree to which they perceived their mentor to be similar to themselves. We used a measure of perceived similarity that was initially developed by Ensher and Murphy (1997) to assess similarity in corporate settings, but has been validated across a variety of settings (e.g., academic; de Janasz & Godshalk, 2013). Protégés were asked to rate on a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) their agreement with the statements “My mentor and I see things in the

same way" and "My mentor and I are similar in our outlook, perspective, and values" (Cronbach's alpha = .80). The two items were averaged and higher scores indicated higher perceived similarity from the protégé perspective ($M = 3.67$, $SD = 0.68$).

Mentor-protégé contact—Consistent with the mentoring literature (Eby et al., 2013), mentor-protégé contact was operationalized in terms of the number of hours the protégé reported spending with their mentor on a weekly basis (i.e., "Approximately how many hours per week during the academic term do you spend with your mentor?"). Responses were recorded in hours per week and ranged from 0 to 40 hours per week ($M = 6.80$, $SD = 7.11$).

Quality of mentorship—The quality of mentorship in an academic context was operationalized along four dimensions. Consistent with prior literature in both workplace and academic contexts, mentoring functions included psycho-social support and instrumental support. Consistent with prior literature in academic contexts, mentoring was also operationalized in terms of mentor guided opportunities for coauthoring experiences (i.e., writing and presenting). Finally, consistent with prior literature in workplace and academic contexts, mentoring was operationalized as the protégés perceptions of relationship satisfaction.

Psycho-social and instrumental support.: Protégés were asked to assess the quality of their mentoring relationships along two dimensions that constitute functional mentoring: psycho-social support and instrumental support. We used a shortened 15-item measure of mentor support initially developed by Dreher and Ash (1990) for corporate settings, but has been validated across a variety of settings (e.g., academic; Tenenbaum et al., 2001). The measure asked protégés about the extent to which their mentor provided them psycho-social support (9-items; e.g., "To what extent has your mentor discussed your questions or concerns regarding feelings of competence, commitment to advancement or relationships with peers") and instrumental support (6-items; e.g., "To what extent has your mentor helped you finish assignments/tasks or meet deadlines that otherwise would have been difficult to complete). The protégés responded to each question on a 5-point scale from 1 (Not at all) to 5 (To a very large extent). Scale scores for each construct were derived by averaging the nine indicators of psycho-social support (Cronbach's alpha = .85; $M = 4.16$, $SD = 0.59$) and the six indicators of instrumental support (Cronbach's alpha = .82; $M = 3.80$, $SD = 0.77$) such that higher scores indicate higher levels of mentoring support received.

Although prior work with this scale indicated a three-factor structure (i.e., psycho-social, instrumental, & networking support), the results were untrustworthy due to inappropriate factor estimation (i.e., principal components analysis with orthogonal rotation) and extraction criteria (i.e., Kaiser rule) being used for correlated latent constructs (Hayton, Allen, & Scarpello, 2004; O'Connor, 2000; Preacher & MacCallum, 2003; Russell, 2002). Our own exploratory factor analysis of the 15-item instrument using principle axis factoring, oblique rotation, parallel analysis, and the minimum average partial test (Velicer, 1976; Velicer, Eaton, & Fava, 2000) recovered the two factor solution described above (i.e., psycho-social and instrumental factors), which was the hypothesized factor structure in the original work (Tenenbaum et al., 2001).

Coauthoring experiences.: Consistent with the graduate mentoring literature (Bauer & Green, 1991) undergraduate protégés were asked a series of five questions about their engagement in scholarly writing in the last six months. Specifically, protégés responded to whether or not (0 = no, 1 = yes) they had engaged in any of the following scholarly writing/coauthoring activities: a) presented original research at an academic research fair or competition ("Yes" = 42%), b) presented a poster at a conference ("Yes" = 34%), c) gave a spoken presentation at a conference ("Yes" = 9%), d) submitted a paper for publication on which they were listed as an author ("Yes" = 14%), or e) been an author on a paper accepted for publication ("Yes" = 10%). Protégé responses were summed to create an index of coauthoring experiences and responses ranged from 0 to 4 ($M = 1.05$, $SD = 1.22$).

Relationship satisfaction.: Protégés were asked to assess their overall satisfaction with the mentoring relationship. As above, we assessed relationship satisfaction with a 3-item measure that was initially developed by Ensher and Murphy (1997). Protégés were asked to rate on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree) the extent to which they were satisfied with their mentor (e.g., "I am satisfied with my mentor"). The three items were averaged and higher scores indicated higher levels of overall relationship satisfaction with the mentor from the protégé perspective (Cronbach's alpha = .80, $M = 4.26$, $SD = 0.68$).

Scientific research career commitment.—Commitment to a scientific research career was operationalized by asked three questions about protégés' interest in and intention to pursue science higher education and careers (Author et al., 2015). Specifically, protégés were asked: "What is your interest in pursuing a doctoral degree in biomedical sciences?", "To what extent do you intend to pursue a science related research career?", and "How likely is it that you will attend graduate school?" All answers were on a scale from 0 (*Definitely will not*) to 10 (*Definitely will*). The three items were averaged and higher scores indicated higher levels of commitment to a scientific research career (Cronbach's alpha = .70, $M = 7.49$, $SD = 2.20$).

Control variables.—Basic demographic information regarding gender and initial intentions to pursue a scientific research career (0 = *Definitely will not* to 10 = *Definitely will*) were collected at the beginning of the study (fall 2005; $M = 8.19$, $SD = 1.99$). Protégé gender was effect coded for analyses (i.e., female = −.50, male = .50).

Results

Prior to testing hypotheses, we standardized all continuous variables to enhance the interpretation of results and examined the descriptive statistics and the zero-order correlation matrix among the predictors (e.g., dyad gender homogeneity status), outcomes (e.g., psycho-social support), and control variables (e.g., protégé gender). Continuous variables were centered prior to forming multiplicative terms used in moderation analysis. Descriptive statistics and residual analyses indicted that the outcomes exhibited acceptable distributional qualities for linear statistical models (i.e., normality, homoscedasticity), see Table 1.

Consistent with prior research, the bivariate correlations revealed large positive relationships among most indicators of the quality of mentorship (*r*'s: .59 to .63, see Table 1); however, psycho-social support, instrumental support, and relationship satisfaction were unrelated to coauthoring experiences. In addition, bivariate correlations revealed large positive associations between perceived similarity, psycho-social support, instrumental support, and relationship satisfaction (*r*'s: .44 to .59), as well as weak but statistically significant positive associations between mentor-protégé gender homogeneity and psychosocial support ($r = .15$) and between mentor-protégé racial homogeneity and instrumental support ($r = .13$).

Quality mentoring.

First, we tested the hypotheses that quality mentoring (i.e., psycho-social support, instrumental support, coauthoring experiences, & relationship satisfaction) would be influenced by the interaction of demographic homogeneity and contact (H_1) as well as the interaction of perceived similarity and contact (H_2). Given the strong relationships among some of the indicators of quality mentoring, we conducted a multivariate regression model that simultaneously regressed psycho-social support, instrumental support, and relationship satisfaction on mentor-protégé gender homogeneity status, racial homogeneity status, perceived similarity, contact, and the two-way interactions between contact and the homogeneity/similarity variables, controlling for protégé gender and mentor gender. Finally, although the protégés were from different institutions of higher education, the clustering had a negligible impact on the outcomes. We assessed the clustering effect by estimating a variance component for each outcome and calculating the intra-class correlation coefficient (ICC) for each outcome. None of variance components (estimate using FIML) were statistically significantly different from zero (p's > .17) and the ICC's were as follows: psycho-social support = .07; Instrumental support = .13; Coauthoring < .01; Satisfaction = .03; Career commitment < .01. Together, this information indicates that the between-university variance in the outcomes was not different from chance. In addition, neither theory nor the empirical mentoring literature have identified institutional factors that might influence between-university variability in mentoring outcomes. Therefore, we controlled for nesting (i.e., chance differences across universities) by entering a series of dummy-coded indicators of institution into the regression models (Cohen, Cohen, West, & Aiken, 2003). Box's *M* test of the homogeneity of variance-covariance matrices was non-significant, so we proceeded with the multivariate analysis.

The results of the multivariate analysis were clear. While gender and racial homogeneity were weakly positively correlated with some aspects of quality mentoring, they were not predictive in the regression model. Perceived similarity had a large effect on the quality of mentorship ($\eta^2_{partial} = .41$) and the two-way interaction of perceived similarity by contact ($\eta^2_{partial} = .03$) had a small effect on the quality of mentoring, see Table 2.

Next, to characterize the nature of the multivariate main effect of perceived similarity and the interaction effect of perceived similarity and contact on quality mentoring (H_2) we conducted a Roy-Bargmann stepdown procedure, which controls for Type-I error rate inflation (Tabachnick & Fidell, 2007). First, psycho-social support was regressed on all predictors in the multivariate model. The analysis revealed that perceived similarity had a

unique, large, and positive effect on psycho-social support ($\beta = .55$), see Table 2. Second, instrumental support was regressed on all predictors in the multivariate model, controlling for psycho-social support. Again, only perceived similarity had a unique positive effect on instrumental support ($\beta = .16$), controlling for psycho-social support ($\beta = .48$, 95% CI [.35, .61], $\eta^2_{partial} = .21$).

Third, relationship satisfaction was regressed on all predictors in the multivariate model as well as psycho-social support and instrumental support. This third regression model simultaneously tested the interaction hypothesis (H_2) and tested for the hypothesized effects of mentoring functions on relationship satisfaction (H_3). As above, the analysis revealed that satisfaction was uniquely positively predicted by perceived similarity ($\beta = .25$), but the perceived similarity effect was moderated by contact ($\beta = -.13$). Contrary to expectations (H_2), a simple slopes analysis revealed that perceived similarity was a stronger predictor of satisfaction when mentor and protégé had lower levels of contact compared to when they had higher levels of contact, see Figure 2. In addition, consistent with H_3 the analysis revealed that psycho-social support ($\beta = .31$, 95% CI [.17, .44], $\eta^2_{partial} = .10$) and instrumental support ($\beta = .28$, 95% CI [.16, .41], $\eta^2_{partial} = .09$) uniquely and positively predicted relationship satisfaction.

Because coauthoring was uncorrelated with the other aspects of quality mentoring, it was analyzed in a separate regression model. Coauthoring was regressed on all predictors in the multivariate model to test the interaction hypotheses (i.e., H_1 [demographics × contact] & H_2 [perceived similarity × contact]). The analysis revealed that the only significant effect on coauthoring was that of the two-way interaction of mentor-protégé gender homogeneity by contact ($\beta = .32$), see Table 2. Contrary to expectations (H_1) a simple slopes analysis revealed that when the protégé and mentor had lower levels of contact, protégés in gender homogeneous dyads reported similar levels of coauthoring experiences as those in gender heterogeneous dyads, see Figure 2. However, when protégé and mentor had higher levels of contact, protégés in gender homogeneous dyads reported higher levels of coauthoring experiences compared to those in gender heterogeneous dyads.

In summary, the results indicate that student protégés who see themselves as highly similar to their faculty mentor reported receiving higher levels of psycho-social support, instrumental support, and reported being more satisfied with the mentoring relationship, although the positive effect on satisfaction waned with more frequent contact (i.e., H_3 supported; H_2 partially supported). Furthermore, student protégés with same- or different-gender faculty mentors reported similarly low levels of coauthoring experience when faculty and student spent little time together. However, student protégés with same-gender faculty mentors reported more coauthoring experiences than student protégés with different-gender faculty mentors when faculty mentor and student spent more time together (i.e., H_1 partially supported).

Scientific research career commitment.

Finally, we tested the hypothesis that STEM career commitment was influenced by the quality of mentoring (H_4) by regressing STEM career commitment on all measures of quality mentoring, controlling for all mentoring antecedents (e.g., perceived similarity) and control variables (including initial intentions to pursue a scientific research career). The analysis revealed that the overall regression model explained significant variability in scientific career commitment ($F[40, 193] = 2.50$, $p < .001$, $R^2 = .34$). Inspection of the individual predictors indicated that only coauthoring experiences uniquely positively influenced commitment ($\beta = .16$, 95% CI [.04, .29], $\eta^2_{partial} = .03$) over and above prior intentions to pursue a scientific research career ($\beta = .33$, 95% CI [.20, .46], $\eta^2_{partial} = .12$). Although psycho-social support ($\beta = .16$, 95% CI [−.02, .34], $\eta^2_{partial} = .02$) and relationship satisfaction ($\beta = .17$, 95% CI [−.01, .35], $\eta^2_{partial} = .02$) exhibited positive effect sizes comparable in magnitude to coauthoring and they contributed to the overall predictive model, neither reached conventional levels of statistical significance. Given the substantial correlation between psycho-social support and relationship satisfaction, multicollinearity may have interfered with our ability to detect unique individual effects on commitment.

In summary, the results indicated that faculty mentors influenced their student protégé's commitment to a STEM career through the provision of high quality mentorship. Student protégés that reported having more coauthoring experience, receiving more psycho-social support, and being more satisfied with their mentoring relationship reported higher levels of commitment to a STEM career path – over and above prior commitment levels (i.e., H_4 partially supported).

Discussion

Faculty mentoring has been described as a critical part of interventions aimed at attracting and retaining members of underrepresented groups in STEM disciplines (Maton & Hrabowski, 2004). Mentors act as socializing or influence agents, encouraging protégés to internalize the norms, behaviors, and values of the scientific community (Author et al., 2011b; Davis, 2008). Successful mentors, particularly those that have shared similarities with their protégé, draw talented protégés into STEM professions by providing high quality mentoring, which consists of support functions (i.e., psycho-social, instrumental, and coauthoring) and cultivating protégé relationship satisfaction (Eby et al., 2013). The current study extends the literature by examining the conditions under which protégé's perceive quality mentoring and by examining the relationship between the quality of mentoring and career commitment among African American college seniors in STEM majors.

Effects of antecedents on quality mentoring.

Our study examined the simultaneous effects of relational factors hypothesized to influence the quality of mentoring – specifically, the racial and gender homogeneity of the dyad as well as the protégé's level of perceived similarity. Contrary to the popularly held belief that gender or racial matching is an effective strategy for providing high quality mentorship to

underrepresented minority students (Brown, Davis, & McClendon, 1999; Davis, 2008), our data clearly indicated that protégé perceptions of similarity with their mentor was the dominant factor influencing the quality of mentoring—not demographic similarity. The large effect of perceived similarity on quality mentoring was consistent with findings from academic contexts among mostly White protégés (e.g., doctoral students in mentoring relationships) and meta-analytic evidence across mentoring contexts (Eby et al., 2013; Turban et al., 2002). Thus, the relative importance of similarity in terms of shared outlook and values appears to be just as important for African American college seniors in STEM as it has been shown to be for majority populations in academic and workplace contexts.

In addition, we had hypothesized that mentor-protégé contact would moderate the effect of relational factors on the quality of mentoring; but we found that the expected patterns were not substantiated in these data. Regarding perceived similarity, we expected that higher degrees of perceived similarity would result in higher degrees of quality mentoring when contact was relatively high, but expected negligible benefits if the dyad spent little time together (Harrison et al., 1998; Turban et al., 2002). We found that the effect of perceived similarity was only moderated for one aspect of quality mentoring, that is, relationship satisfaction. And although the perceived similarity effect on relationship satisfaction was moderated by contact, contrary to our expectations higher degrees of perceived similarity resulted in higher degrees of satisfaction when contact was relatively *low* (not high), and results showed negligible benefits if the dyad spent more time together.

Taken together, the pattern of perceived similarity effects on quality mentoring found in these data advance our understanding of how and when mentoring URMs works best in an undergraduate STEM context. Workplace and graduate school mentoring relationships (i.e., common contexts for much of prior literature on perceived similarity effects) typically develop over an extended period of time, often across many years, with relatively fluid times for transitioning between stages (e.g., initiation, separation) of mentoring (Kram, 1983). However, mentoring in the undergraduate context takes place over a relatively short period of time and transitions are relatively fixed (Jacobi, 1991). Thus, the shorter duration and more rigid transitions that define undergraduate mentoring may result in a more consistent correspondence between shared values and support, regardless of whether the mentor and protégé spend more or less time interacting. In summary, these findings suggest that overall for undergraduates in their final year, the quality of mentorship matters more than the quantity of mentorship time.

Implications.—Although readers should be cautious in extrapolating the present findings too broadly, these data may inform the practices of faculty and mentoring programs. Given these findings and findings from the social influence literature (MacKinnon et al., 2011), faculty mentors and mentoring programs should consider making explicit efforts to foster student's perceptions of similarity across a wide variety of topics. Recent research with teachers and students indicates that explicit efforts to identify similarities on a wide variety topics (e.g., ideal field trip, important qualities in friends, family in the military; Gehlbach et al., 2016) engendered perceptions of similarity, which in turn, benefited student's motivation and performance, particularly for URMs (Gehlbach et al., 2016). Faculty members from majority groups who are mentoring URM students may wish to set aside time early in the

relationship for a “getting to know each other” meeting. Finding and affirming commonalities, even seemingly surface level commonalities (e.g., leisure activities, food or travel preferences, or preference for glasses or contact lenses) can enhance the URM’s (and the faculty member’s) perceptions of similarity, which may benefit the quality of the mentoring relationship. Faculty members from underrepresented groups may also benefit from deliberate efforts to find commonalities with their URM students as there is convergent evidence that demographic similarity alone does not enhance the quality of the mentoring relationship. In addition, given these data, efforts to foster student perceptions of similarity may compensate for less contact between faculty mentor and the student.

Regarding demographic homogeneity, we expected that protégés in demographically homogeneous dyads would experience higher quality mentoring when contact was relatively low, but expected the benefit would dissipate as the dyad spent more time together (Harrison et al., 1998; Turban et al., 2002). Furthermore, researchers have suggested that race matching might be particularly important for racial minorities because same-race role models may support positive self-appraisals and academic self-efficacy (Blake-Beard et al., 2011). In general, however, the protégé matching the mentor’s ethnicity or gender did not have a significant impact on perceptions of mentorship quality. For example, we found that the racial homogeneity of the dyad did not influence any aspect of the quality of mentoring. However, there was one exception. We found that the gender homogeneity effect on coauthoring was significantly moderated by contact, but contrary to our expectations protégés in gender homogeneous dyads reported more coauthoring experiences when contact was relatively *high* (not low), and results showed negligible benefits as the dyad spent less time together. This finding is novel in the STEM mentor matching literature, as prior studies focused on demographic matching have rarely incorporated coauthoring experiences as a relevant form of support (Blake-Beard et al., 2011; Turban et al., 2002). And prior studies of mentoring in STEM fields that did incorporate coauthoring experiences as relevant forms of support have not focused on matching characteristics (Bauer & Green, 1994; Paglis et al., 2006). Thus, these findings indicate that undergraduate protégés in STEM may garner some small benefits related to coauthoring experience when matched with a same-gender faculty mentor. Given the make-up of our sample (80% female protégés – 87% majoring in biological or natural sciences), it may be possible that female faculty mentors (who are themselves underrepresented in the natural sciences) in gender homogeneous dyads were particularly motivated to have higher levels of contact with female protégés and provide ample opportunities to coauthor. However, further research is needed to better understand the gender homogeneity by contact interaction effect.

Effects of quality mentoring on STEM career commitment.

Theory and empirical evidence suggest that mentors help to socialize protégés into a professionate through the provision of quality mentoring (Author et al., 2015; Bauer & Green, 1994; Chemers et al., 2011; Davis, 2008). Therefore, the current study also focused on the simultaneous effects of the quality of mentoring on STEM career commitment. Consistent with our expectations, the effect sizes for coauthoring experiences, psycho-social support, and relationship satisfaction were all moderate and positive, controlling for the large effect of prior career commitment. These findings are consistent with the social

influence and mentoring theories, which suggests that mentors draw talented protégés into a profession through quality mentoring. Although prior research with mentored undergraduate minority science student protégés and majority science graduate student protégés suggested that instrumental support should influence career commitment (Chemers et al., 2011; Paglis et al., 2006), the lack of confirmation of previous findings may be due to differences in what was measured and stage of career development. Specifically, most prior studies with STEM protégés have not included coauthoring experiences as a form of quality mentorship. Furthermore, the prominence of instrumental support may wane in importance relative to coauthoring experiences during the critical period sampled in this study, that is, senior year in college. Therefore, future research in STEM and academic contexts should include both measures of instrumental support, coauthoring experiences, and be sensitive to different levels of influence depending upon the protégé's stage of career development.

Limitations and future directions.

Although the current study addresses key gaps in the literature, there are several limitations to consider when generalizing from this study. The current study focused on the mentoring experiences of African American seniors in STEM majors. Focusing on this unique group of protégés allows for the testing of theoretical relationships regarding mentorship and responds to a gap in understanding the experiences and outcomes for underrepresented minorities in STEM oriented careers. However, the focus solely on minorities' experiences limits generalizations to and comparisons with majority counterparts in STEM.

The current study also focused on the college senior year because it represents a critical period in career development, that is, students make key decisions and commitments regarding their future in STEM during this time. The single time point captured for this study is an important period, but, represents a single and limited snapshot in time. Therefore, inferences about growth and development over time, as well as inferences about individual differences and contextual factors that influenced the developmental trajectories prior to senior year were outside the scope of this study. Future studies should examine how undergraduate mentoring relationship in STEM evolve over time from initiation earlier in college through separation and redefinition periods post-graduation. A related limitation concerns the nested structure of the data. Just as protégés are nested within time, they are also nested within university contexts. The current study controlled for chance differences across universities, in part, because mentoring theory does not clearly identify institutional predictors of the quality of mentoring. The mentoring literature for undergraduates (in general or in STEM) has focused on characteristics of the mentor and protégé that enhance the quality of the relationship rather than on institutional characteristics that may enhance or diminish the quality of mentoring. Future theorizing and research should consider institutional characteristics that might enhance mentoring, for example institutional adoption of the "Entering Mentoring" curriculum (Handelsman, Pfund, Lauffer, & Pribbenow, 2005) or similar institutionalized efforts to train or support faculty mentorship.

The current study was also limited to self-reported data rather than objective measures of mentoring success. For example, self-reported career commitment (i.e., intentions to pursue a scientific research career) served as a proximal outcome for more distal behaviors.

Although behavioral outcomes are desirable, experimental evidence show that early intentions are linked to later behaviors (Webb & Sheeran, 2006). In addition to behavioral intentions, future studies should consider other downstream measures of mentoring success, such as applications or acceptances into STEM oriented graduate degree programs, future academic productivity (e.g., future publications), or the attainment of a STEM related career. Future studies should also considering incorporating the perspective of the mentor.

An additional limitation, in terms of measurement, concerned the measurement of the lab experience for the protégés. Undergraduate researchers often apprentice in labs with a small number of other novice and advanced scientific protégés (e.g., peers, graduate students, postdoctoral fellows), all of whom are being mentored by a faculty member. The lab may represent a micro community with a shared mentoring experience that influences the protégé's perception of their mentoring experience. At present little is known about how shared mentoring experiences influences the protégé's perceptions of similarity, mentoring support, or relationship quality. Future studies should measure qualities of the lab that may influence the mentoring experience. On a related note, some of the measures employed in the current study need further psychometric validation, particularly within undergraduate populations. For example, the present study found a two-factor model provided the best fit for mentor support functions, whereas prior work with graduate student protégés indicated a three factor model (Tenenbaum et al., 2001). And although the measure of coauthoring experiences is consistent with measures used with graduate student protégés (e.g., Green & Bauer, 1995), the measurement properties may operate differently at the undergraduate level. Further, the psychometric properties of some of the individual items (e.g., "My mentor and I are similar in outlook, perspective, and values") may be capturing related but distinguishable aspects of perceived similarity. Finally, the measure of contact (i.e., number of hours per week) captured an aspect of the intensity or frequency of the interactions, but did not capture the content of the interactions (e.g., working side-by-side in the lab, simply working on the mentor's project, etc.). Future studies should continue to examine and refine the evidence of measurement validity for these measures of mentoring.

Conclusion

Overall and consistent with social influence and mentoring theories, our study indicated that mentors act as socializing agents, drawing underrepresented protégés into STEM careers through the quality of the mentoring (i.e., provision of psycho-social support, instrumental support, coauthoring experiences, and cultivation of relationship satisfaction). In addition, the present research indicated that for underrepresented students in STEM disciplines, matching mentor and protégés based on shared perspectives and values may be more important than matching based on demographics alone.

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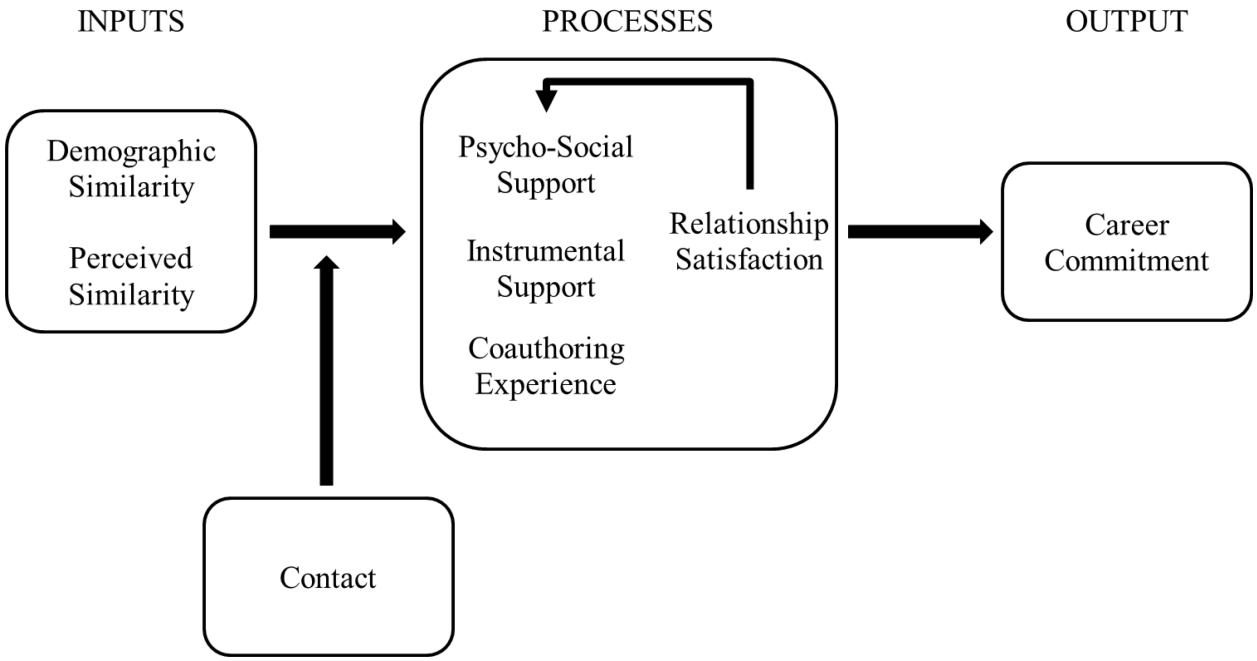

Figure 1. Process model of mentoring.

Process model based on the work of Eby et al. (2013). Note, that we modified their model by proposing that contact would moderate the relationship between similarity (inputs) and mentoring functions (processes).

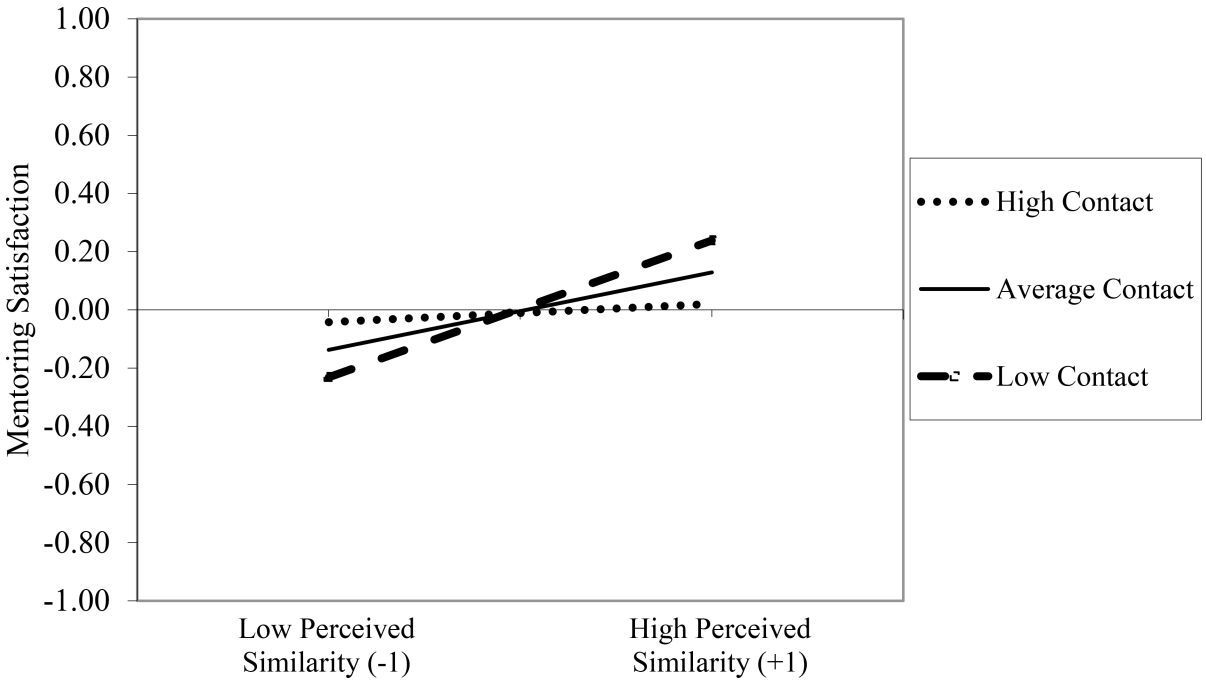

Figure 2.
Simple slopes depicting the effect of perceived similarity on mentoring satisfaction at high (+1*SD*), average (*M*), and low (−1*SD*) levels of contact.

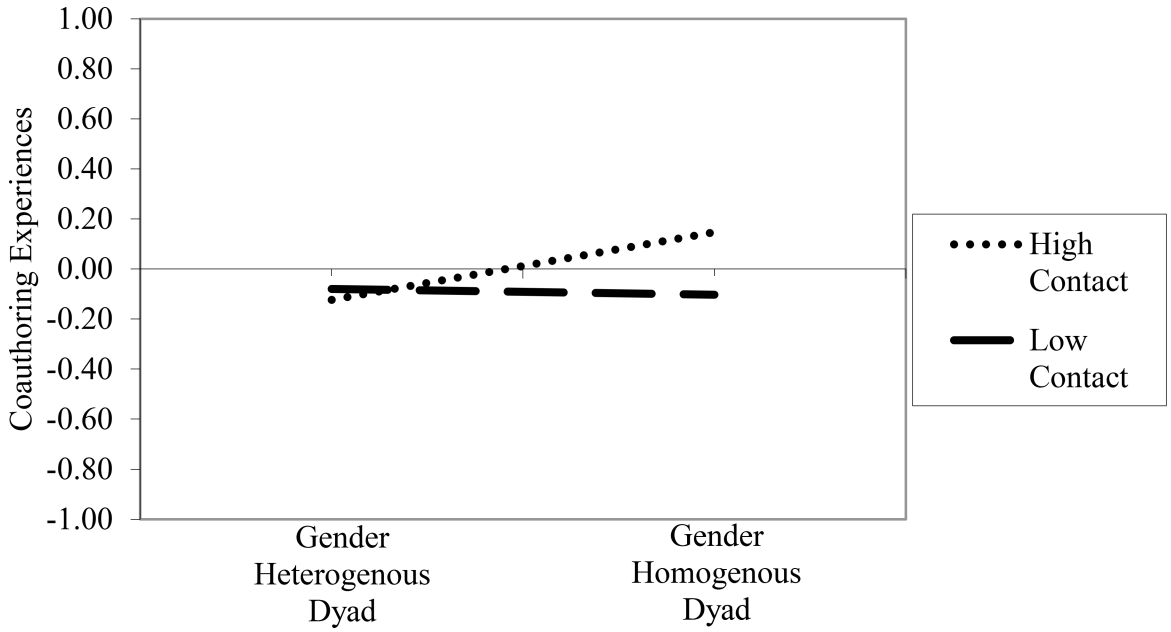

Figure 3.

Simple slopes depicting the effect of gender homogeneity status on protégé coauthoring experiences for dyads with relatively low (−1 SD) or high (+1 SD) contact.

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Table 1.

Descriptive Statistics and Correlation between Mentoring Antecedents (e.g., Similarity), Quality Mentorship (e.g., Psycho-Social Support), and Outcomes (e.g., career commitment).

	Variable	*M*	*SD*	Skew	Kurtosis	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Initial Career Commitment	−0.03	1.01	−1.02	0.28	--	.11	.09	−.04	−.09	.13*	.12	−.03	.01	.06	.10	.17**	.17*	.05	.39**
2.	Protégé Gender	−0.31	0.39	1.63	0.65		--	.23**	.16*	.04	.02	.10	.04	.07	.09	−.13	−.01	−.05	.00	.04
3.	Mentor Gender	0.01	0.50	−0.04	−2.02			--	−.64**	−.19**	−.04	.08	.08	−.02	.09	−.16*	−.05	−.05	.01	−.01
4.	Gender Homogeneity (G.H.)	0.08	0.49	−0.34	−1.90				--	.13	.13*	−.08	.01	−.02	−.06	.15*	.04	.05	.04	.05
5.	Racial Homogeneity (R.H.)	0.05	0.50	−0.20	−1.98					--	.10	−.02	−.01	.00	−.16*	.07	.13*	−.07	.02	−.07
6.	Perceived Similarity (P.S.)	0.00	1.00	−0.03	−0.34						--	−.04	−.06	−.15*	−.04	.59**	.44**	−.05	.56**	.10
7.	Contact (C)	0.00	1.00	2.11	5.67							--	.15*	.19**	−.13*	−.01	.07	.11	.07	.10
8.	G.H. × C	−0.04	0.50	0.60	5.94								--	.21**	−.18**	−.06	.00	.15*	.04	.01
9.	R.H. × C	−0.01	0.50	1.03	5.77									--	−.17**	−.17**	−.11	.04	−.08	−.06
10.	P.S. × C	−0.04	0.96	0.42	12.48										--	−.06	−.02	.00	−.15*	−.04
11.	Psycho-Social Support	0.00	1.00	−0.54	−0.19											--	.59**	.06	.63**	.19**
12.	Instrumental Support	0.00	1.00	−0.55	0.17												--	.07	.61**	.12
13.	Coauthoring Experiences	0.00	1.00	0.78	−0.54													--	.06	.25**
14.	Relationship Satisfaction	0.00	1.00	−0.89	0.63														--	.16*
15.	Career Commitment	0.00	1.00	−0.93	0.05															--

Notes: Protégé gender coded (−.50 = female, .50 = male), mentor gender coded (−.50 = female, .50 = male), gender homogeneity coded (−.50 = heterogeneous, .50 = homogeneous), racial homogeneity coded (−.50 = heterogeneous, .50 = homogeneous).

*p<.05

**p<.01

Table 2.

Summary of multivariate and univariate linear statistical models for mentoring received as a function mentoring antecedents.

			Univariate											
			Psycho-social Support[c]			**Instrumental Support**[d]			**Mentorship Satisfaction**[e]			**Coauthoring Experiences**[f]		
	Multivariate[a]		$F(40, 196)=4.86^{***}$, $R^2=.50$			$F(41, 195)=6.05^{***}$, $R^2=.56$			$F(42, 194)=8.32^{***}$, $R^2=.64$			$F(40, 196)=1.01$, $R^2=.17$		
Predictor	$F(3, 194)$[b]	η^2_p	β	*CI*[LL, UL]	η^2_p	β	*CI*[LL, UL]	η^2_p	β	*CI*[LL, UL]	η^2_p	β	*CI*[LL, UL]	η^2_p
1. Protégé Gender	$2.49^{\dagger}$	.04	−.30	[−.63, .03]	.02	.27	[−.04, .59]	.01	.17	[−.12, .46]	.01	−.22	[−.64, .21]	.01
2. Mentor Gender	0.52	.01	−.08	[−.39, .24]	<.01	−.11	[−.41, .18]	<.01	.12	[−.15, 0.39]	<.01	−.05	[−.45, .35]	<.01
3. Gender Homogeneity	1.27	.02	.14	[−.17, .46]	<.01	−.23	[−.52, .07]	.01	−.11	[−.37, .16]	<.01	.14	[−.26, .54]	<.01
4. Racial Homogeneity	$2.24^{\dagger}$	.03	−.06	[−.30, .18]	<.01	.16	[−.06, .39]	.01	−.22	[−.42, −.01]	.02	−.26	[−.57, .05]	.01
5. Contact	1.50	.02	.08	[−.03, .18]	.01	.06	[−.05, .17]	.01	.05	[−.05, .15]	.01	.10	[−.05, .24]	.01
6. Perceived Similarity	44.36^{***}	.41	.55	[.44, .66]	.33	.16	[.03, .29]	.03	.25	[.14, .37]	.09	00	[−.14, .14]	<.01
7. GH×C	0.31	.01	−.01	[−.24, .21]	<.01	.01	[−.20, .23]	<.01	.09	[−.10, .29]	<.01	32	[.02, .61]	.02
8. RH×C	0.81	.01	−.16	[−.40, .07]	0.01	−.08	[−.30, .14]	<.01	−.01	[−.21, .19]	<.01	.01	[−29, .31]	<01
9. PS×C	$2.19^{\dagger}$	.03	−.02	[−.14, .10]	<.01	.00	[−.11, .11]	<.01	−.13	[−.23, −.02]	.03	.07	[−.08, .22]	<.01

Note: F values for dummy-coded school indicators not shown for the sake of parsimony.

[a] coauthoring experiences not included in the multivariate model since it was uncorrelated with the other mentoring received outcomes

[b] *F* statistic for multivariate model based on Wilks' Lambda statistic

[c] Mentor gender, gender homogeneity, perceived similarity, and the racial homogeneity × contact interaction were significantly correlated with psycho-social support in bivariate analyses (Table 1)

[d] Initial career commitment, racial homogeneity, and perceived similarity were significantly correlated with instrumental support in bivariate analyses (Table 1)

[e] perceived similarity, psycho-social support, and instrumental support were significantly correlated with relationship satisfaction in bivariate analyses (Table 1)

[f] Initial career commitment and the gender homogeneity by contact interaction were significantly correlated with coauthoring experiences in bivariate analyses (Table 1)

η^2_p = partial eta-squared for each source; CI = 95% Confidence Intervals.

$^{\dagger}p<.10$

$^{*}p<.05$

** $p<.01$

*** $p<.001$