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Individual Differences in Preferences for Matched-Ethnic Mentors Among High-Achieving Ethnically Diverse Adolescents in STEM

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This short-term longitudinal study examined (a) adolescents' contact with mentors who share their background in relation to the importance they place on having such mentors, and (b) the associations of these perceptions with self-efficacy, identity, and commitment to a science career. Participants were 265 ethnically diverse adolescents (*M* age = 15.82) attending a 4-week science education program. Cluster analyses indicated that at Time 1, underrepresented ethnic minorities were more often in the cluster defined by feelings of importance of having a matched-background mentor but not having much contact. Perceptions of contact increased over time for these students and were associated with increased feelings of identity as a science student. The results suggest the need for attending to individual differences in students' preferences for matched-background mentors.

Participation in science, technology, engineering, and math (STEM) undergraduate and graduate programs continues to be low for underrepresented ethnic minority students (URMs), defined as students from African, Latino, and Native American heritages (Gándara & Maxwell-Jolly, 1999). For example, in 2008 URMs accounted for 18% of all bachelor's degrees earned in the United States but only 15% of all degrees in STEM (National Science Foundation, 2010). In comparison, White students are well represented (68% of all degrees, 67% of STEM) and Asian Americans are overrepresented (7% of all degrees, but 12% of STEM). The gap continues to widen in graduate school and into the professoriate, where approximately 7% of STEM faculty are URM, compared to 19% Asian American and 72% White.

The ethnic disparities in STEM participation have their roots in earlier phases of education. Researchers have documented the numerous barriers faced by middle and high school students interested in pursuing STEM fields, including poor educational facilities, lack of availability of advanced science classes, inadequately prepared teachers, and language barriers, among many others (Brown & Campbell, 2008; Cooper, Chavira, & Mena, 2005; Rochin & Mello, 2007; Solorzano & Ornelas, 2004). The lack of mentors and role models that share the background of URM students is often considered a significant barrier to their intention to pursue a career in STEM. However, much of the research on the effects of matched-background mentors has assumed that such a match is desirable to the individual (e.g., Ensher & Murphy, 1997; Rhodes, Reddy, Grossman, & Lee, 2002). That is, the existing research has scarcely examined the degree to which the students view this match as personally important. The purpose of the present study is to address this question with a short-term longitudinal study of ethnically diverse adolescents.

The Importance of Mentoring

Research on the general processes of mentoring has found consistent links between positive mentoring experiences and a host of positive behavioral,

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mental health, and academic outcomes (Bearman, Blake-Beard, Hunt, & Crosby, 2007; DuBois, Holloway, Valentine, & Cooper, 2002; Karcher, 2008; Rhodes, Spencer, Keller, Liang, & Noam, 2006). For example, one study found that higher quality mentoring relationships were related to several aspects of youth competence, including feelings of connectedness to school, greater self-efficacy, and more positive social relationships (Zand et al., 2009). Others have demonstrated the protective effects of mentoring on behavioral problems and substance use (Reglin, 1998; Rhodes, Reddy, & Grossman, 2005).

The research cited earlier has primarily focused on the quality of the mentoring relationship and thus is contingent on the adolescents actually having a mentor. Sanchez, Esparza, and Colón (2008) found that Latino adolescents who reported having a mentor also reported greater academic success and school belongingness than those who did not report a mentor, and there were additive effects for each additional mentor reported. Social psychological research on ''possible selves'' has complemented these studies by highlighting the importance of having mentors from similar social backgrounds (e.g., ethnicity) that ethnic minority adolescents can draw from when visualizing their future (Markus & Nurius, 1986; Oyserman, Gant, & Ager, 1995; Zirkel, 2002). Indeed, research on mentoring with adolescents has examined how having a matched-ethnic mentor is associated with the mentoring relationship, although the results are mixed. For example, one study found that having a matched mentor was associated with a higher quality mentoring relationship (Ensher & Murphy, 1997), whereas another found little to no benefits of having a matched mentor in terms of educational and behavioral outcomes (Rhodes et al., 2002). Studies with college and adult populations have produced similarly inconsistent results (e.g., Ortiz-Walters & Gilson, 2005; Turban, Dougherty, & Lee, 2002).

In the context of STEM education, the ability to construct an imagined future in the field is hindered considerably by the very small number of ethnic minority teachers and professors (Gándara & Maxwell-Jolly, 1999). It is important to note that most inquiries into ethnic disparities in STEM participation make use of three ethnic categories: URM, Asian American, and White, due to their shared levels of representation (Gándara & Maxwell-Jolly, 1999). As previously indicated, Asian Americans are *overrepresented* in STEM and Whites are right on target. URMs are underrepresented, and the extent of underrepresentation is similar for the three ethnic groups that constitute URMs (i.e., African American, Latino, and Native American). These patterns of representation correspond to ethnic categorizations used by both the National Science Foundation and National Institutes of Health in the context of STEM participation, and therefore are the basis for funding of science support programs (National Institute of General Medical Sciences, 2010). Thus, the relatively few URM students in STEM paired with the low availability of same-ethnicity mentors suggest that having mentors who share their background may be particularly important for URM adolescents, compared to Asian American and White adolescents.

Beyond Contact: Considering Individual Differences in Adolescents' Preferences

The importance of having mentors who share ethnic minority students' backgrounds is frequently cited. Despite such assertions, the empirical literature is far from clear on whether having a matched-background mentor matters for academic and attitudinal outcomes. A major limitation in the existing literature is that researchers have not considered whether having a matched-background mentor is personally important to the individual. It is generally assumed that, on account of their ethnic minority status, students will desire to have a mentor from a similar ethnic background. However, this is not necessarily the case, as research has soundly documented the variability that exists in ethnic minorities' attitudes about their own group (Phinney, 1990; Syed, Azmitia, & Phinney, 2007).

Surfacing this unchecked assumption in the literature suggests the existence of two key dimensions of the matched-background mentor experience. On the one hand, there is the dimension of *contact*, corresponding to the degree to which students have had exposure to mentors that share their background. This dimension has served as the primary focus of past research and has been examined both in terms of having a mentor and in the frequency of contact adolescents have with the mentor (Ensher & Murphy, 1997; Sanchez et al., 2008; Zirkel, 2002). The second dimension, *importance*, corresponds to how much students actually desire to have a matched-background mentor. This dimension has received very little attention and may be an important individual difference variable that can help resolve the inconsistent findings of past research.

Although potentially related, it may be useful to conceptualize the two dimensions of contact and importance as independent from one another and empirically examine how they are related. In particular, using a person-centered approach would allow for an understanding of individual differences in how personally important it is for adolescents to have matched-background mentors in relation to their reported contact with such mentors. Person-centered analysis focuses on the variability between individuals in the interrelations among psychological constructs and has been advocated as a method for conceptualizing human experiences as ''integrated, holistic processes in terms of patterns of working components'' (Magnusson, 2003, p. 19). There are several advantages of a person-centered approach, such as cluster analysis used in the current study, over a variable-oriented approach (e.g., multiple regression). A person-centered approach allows for a separation of (a) the diversity of interrelations among constructs and (b) the implications of the different patterns for relevant outcomes (Roeser & Peck, 2003). By contrast, multiple regression tests for how multiple variables interact in the context of their meaningfulness for some dependent variable. A person-centered approach is appropriate in the present study because it is better aligned with two of our primary goals. First, we aim to explore the nature of subgroups in the interrelations between contact and importance. For example, the two dimensions could constitute a bidimensional model that produces four matched-mentor typologies (i.e., high contact and high importance, high contact and low importance, low contact and high importance, and low contact and low importance). This is an empirical question, and cluster analysis permits the possibility of different configurations, including an absence of one of those described. Once we establish the nature of the subgroups, we can then test for whether the observed subgroups differ along important indicators of academic success and engagement, a subject to which we now turn.

Matter for What? Psychological Processes Associated With Academic Success

Of course, the reason we are interested in whether URM students have matched-background mentors is to examine whether it matters for important educational outcomes. Research with adolescents who were not necessarily in STEM fields has indicated that having matched-background mentors is more strongly related to attitudinal and psychosocial outcomes than it is to academic outcomes (Ensher & Murphy, 1997; Rhodes et al., 2002). In the present study, we examined three psychosocial factors that are strongly related to academic outcomes in the context of STEM: science self-efficacy, identity as a science student, and commitment to pursue a career in science.

Self-efficacy, or the belief in having a sense of ability and competency to accomplish a goal, has been strongly linked to performance in a number of different domains (Bandura, 1995). Within the domain of academics, self-efficacy has been demonstrated to predict academic performance, academic engagement, and intrinsic motivation (Chemers, Hu, & Garcia, 2001; Fan & Williams, 2010; Lent, Brown, & Hackett, 1994). While self-efficacy provides students with the confidence to succeed, identity facilitates feelings of belongingness and connection (Ashmore, Deaux, & McLaughlin-Volpe, 2004; Erikson, 1968). Numerous studies have documented the importance of having a sense of identity with an academic subject to realize success and persistence in that subject (Eccles & Barber, 1999; Syed, 2010). Lastly, we considered the adolescents' stated intent to pursue a career in STEM. Assessing students' perceived commitment taps into the degree to which they have thought ahead to their career and whether they see themselves as actually becoming scientists. In the present study, we examined how individual differences in the interrelatedness of contact and importance were associated with these three psychological processes.

The Contexts of Youth Mentoring: Natural Mentor Relationships

The literature on youth mentoring primarily focuses on formal mentoring relationships, wherein mentors are assigned to protégés and often work together in one-on-one relationships (DuBois et al., 2002; Ensher & Murphy, 1997; Karcher, 2008; Rhodes et al., 2002). In recent years, there has been an emergent interest in what are called natural mentor relationships, or spontaneous mentoring, which includes informal mentoring relationships such as with extended family members or teachers (Scandura, Tejeda, Werther, & Lankau, 1996; Zimmerman, Bingenheimer, & Behrendt, 2005; Zippay, 1995). A far greater number of individuals engage in natural mentor relationships than formal programs, suggesting that natural mentoring is the most commonplace context for mentoring to occur (DuBois & Silverthorn, 2005).

In this study, we examine a sample of adolescents who were situated within a formal educational setting involving natural mentor relationships. The adolescents in this study were participating in a 4-week residential summer science camp (described in more detail in the following sections). Thus, they were part of a formal program geared toward providing them with educational experiences that will sustain their motivation to pursue a career in science. Although the adolescents were participating in a formal program, the context of the mentoring that occurred was natural, in that students were not assigned to work with specific faculty mentors. Rather, they engaged with a number of faculty, graduate students, high school teachers, and residential staff while participating in interactive, hands-on research experiences in university labs and facilities. Thus, the context of the mentoring that occurred was more similar to what might occur naturally in high school than to a formal mentoring program.

The Present Study

The present short-term longitudinal study aims to address the gap in the literature on matched-background mentors by adopting a person-centered approach that is attentive to individual differences in how adolescents perceive the importance of having a matched-background mentor. To this end, there were three primary goals: (a) assess adolescents' contact with mentors who share their background in relation to how important it is for them to have a match, (b) explore variations in these patterns by ethnicity, and (c) examine whether these perceptions are associated with psychological processes related to academic success: science self-efficacy, identity as a science student, and commitment to a career in science. By including assessments at both the beginning and end of the program, we were also able to examine how adolescents' perceptions of having a matched-background mentor changed over the course of the program and whether these changes were associated with changes in self-efficacy, identity, and commitment.

Method

Setting

The California State Summer School for Mathematics and Sciences (COSMOS) is a 4-week residential program established by the California State Legislature. The aim is to ''motivate the most creative minds of the new generation of prospective scientists, engineers, and mathematicians so that they may actively participate in the business and higher educational sectors of the State of California.'' The current study was conducted with COSMOS at the Santa Cruz campus.

High school students who are recognized by their teachers as talented and motivated in science and mathematics are invited to apply. COSMOS staff members aim to recruit a heterogeneous group of qualified applicants. To ensure equal access to this opportunity, staff members make outreach visits to school and community groups across the state to explain the program to teachers, counselors, students, and parents. Building on personal connections, recruiters attend teacher and counselor conferences across the state. To recruit students from non-college-going families, COSMOS staff members distribute brief English- and Spanish-language flyers that explain the educational program as well as campus safety, family visits, and financial aid.

Each year, 150 students are chosen to attend. Instructional staff members select students based on a match between students' expressed academic interests and instructor perceptions of student readiness to benefit from academic content. Additional information that is considered in the selection process is science and math course-taking history, student essays, and teacher recommendation letters.

The academic program entails six contact hours daily Monday through Friday, consisting of hands-on coursework, academic field trips, and science lectures. The academic programs are led by 20–25 instructors (university professors, researchers, and advanced graduate students), 9 high school teachers, as well as the 20 residential staff members who support academics by day and coordinate afternoon, evening, and weekend recreation and student activities. Essentially, students' time is structured for meals, academic, or residential activities from 8 a.m. through 10 p.m. each day for 4 weeks. Instructional staff members involve students in creative courses in topics such as astronomy, ocean science, and robotics. Students participate in interactive, hands-on experiences in university labs and facilities. The 4-week experience culminates in a final project, for which students define a research question, gather data to answer the question, and present the results to their peers at COSMOS. After they return to their home community, they also make a presentation to a school or community group.

The explicit integration of academic and residential programs provides students with many opportunities to develop informal, spontaneous

mentoring relationships among staff members at all levels. This is not a planned mentoring program in which each student is assigned one or more mentors. Rather, students interact with academic and residential staff members both formally in coursework and informally during field trips, meals, and recreational activities. Although precise numbers are not available, the camp makes extra efforts to ensure ethnic diversity among professors, researchers, graduate students, high school teachers, and residential staff members. As is evident from the pattern of results below, students perceived the camp to be of sufficient diversity to report having contact with same background mentors through the course of the 4 weeks.

Participants

Participants were 292 adolescent high school students (M age = 15.82, SD = 0.96; 57% female) attending a 4-week residential science education program. This sample reflects 95% of all students attending the program, but 27 adolescents were removed due to missing data on key study variables, leaving a final sample size of 265 adolescents (57% female). As discussed in the Introduction, ethnicity was grouped into three categories: 27% URM (mostly Latino and African heritage), 34% White, and 39% Asian American. Our indictor of socioeconomic status (SES) was whether the students received financial aid to attend the program, which was based on the students' eligibility for federal free or reduced school lunch programs (38% received financial aid). Whether the students received financial aid varied significantly by ethnicity: URM adolescents were much more likely to receive financial aid than were White and Asian American adolescents, $\chi^2(2) = 52.19$, $p < .001$, $\nu = .44$. The adolescents in the sample were extremely high achieving, with an average weighted high school GPA of 4.18 (SD = 0.50). There were significant ethnic differences in GPA, $F(2, 262) = 17.79$, $p < .001$, $\eta_p^2 = .12$, with Tukey's honestly significant difference (HSD) post hoc tests indicating that URM students (M = 3.90, SD = 0.57) had significantly lower GPAs than did White and Asian American students (M = 4.19, SD = 0.43 and M = 4.34, SD = 0.41, respectively). Despite this difference, the sample as a whole was clearly very successful academically.

Measures

The adolescents completed a survey in the first few days of the program (Time 1) and again 4 weeks later in the last few days of the program (Time 2). The survey contained numerous scales, but the present study focuses only on the subset reported in the following sections. The survey measures used here are part of a larger project of ethnic minority persistence in STEM fields. The measures were initially developed for undergraduate students using both relevant literature and interviews with college program staff members and STEM alumni. To ensure that we were using item language and content appropriate to the context of STEM, we interviewed 13 program staff members, 20 faculty mentors, and 9 program alumni. Interview responses were discussed by the research team and integrated into the pilot survey measures. The survey was piloted using a think-aloud protocol with 13 former science support participants, providing further information for refinement of language and response alternatives. Original items developed through interviews and literature reviews were subjected to factor analyses conducted separately for major ethnic groupings (White, Asian, URM) to assess the factorial invariance of the scales. In consultation with program staff and researchers, the initial scales were modified for use with adolescent samples to ensure item content was developmentally appropriate.

Impact of background on science experiences (Chemers et al., 2010). This eight-item scale contains questions about the role of the students' background for their science experiences. In the instructions to the scale ''background'' was defined as ethnicity, gender, and social class, and students were encouraged to consider all of these aspects when completing the scale. Participants responded on a 5-point scale with higher values indicating greater contact and importance (1 = *strongly disagree* to 5 = *strongly agree*). Exploratory factor analysis of the eight items was conducted using maximum-likelihood extraction and varimax rotation. The resultant scree plot clearly indicated two factors (both eigenvalues > 2.0), so we proceeded to rotate the two-factor solution for interpretation. The rotated solution provided clear evidence of simple structure, with all primary loadings exceeding .40 and all cross-loadings lower than .20 (Tabachnick & Fidell, 2007). These two distinct factors, each containing four items, corresponded to (a) how much contact they have had with mentors that share their background (*contact*) and (b) how important it is for them to have mentors that share their background (*importance*). The items for each of the scales were averaged together so that greater values represent greater contact and importance. Intercorrelations

between the scales were modest, $r_{T1} = .17$, $r_{T2} = .19$, suggesting that they are distinct but could potentially overlap. A sample item for the contact subscale is, ''I have had one or more mentors who came from the same background as me'' and a sample item for the importance subscale is, ''Knowing that there are scientists with my background makes me feel more like a science student.'' Cronbach's alphas for the contact subscale were .79 at Time 1 and .80 at Time 2, and for the importance subscale .83 at Time 1 and .86 at Time 2.

Science self-efficacy (Chemers et al., 2010). This 10-item scale assesses domain-specific and stage-appropriate beliefs about confidence in conducting scientific research. The scale was developed based on the previous work of Bandura (1997), Chemers et al. (2001), and Kardash (2000). A sample item includes, ''I am confident that I can use scientific literature and/or reports to guide research.'' Participants responded on a 5-point scale with higher values indicating greater self-efficacy. Cronbach's alphas were .92 at Time 1 and .93 at Time 2. This construct has been predicted by greater research experiences, quality mentoring experiences, and STEM community involvement in previous analyses with high school, undergraduate, and graduate student samples.

Identity as a science student (Chemers et al., 2010). This seven-item scale assesses students' sense of identity and belongingness as a science student. The scale was developed based on the work of Sellers (e.g., Sellers, Smith, Shelton, Rowley, & Chavous, 1998) and Luhtanen and Crocker (1992) as well as interviews conducted as a part of a different project (Chemers et al., 2010). A sample item includes, ''Being a science student is an important reflection of who I am.'' Participants responded on a 5-point scale with higher values indicating higher levels of identity. Cronbach's alphas were .90 at Time 1 and .89 at Time 2. This construct has been predicted by greater research experiences, quality mentoring experiences, and STEM community involvement in previous analyses with high school, undergraduate, and graduate student samples.

Commitment to pursue a career in science (Chemers et al., 2010). This seven-item scale assesses students' intention to pursue a career in a science-related field. A sample item includes, ''I will work as hard as necessary to achieve a career in science.'' Participants responded on a 5-point scale with higher values indicating higher levels of commitment. Cronbach's alphas were .95 at Time 1 and .93 at Time 2. This construct has been predicted by greater research experiences, quality mentoring experiences, STEM community involvement, greater science self-efficacy, and greater identity as a science student in previous analyses with high school, undergraduate, and graduate student samples.

Results

Preliminary Analysis

Descriptive statistics for all study variables, separated by ethnicity and time point, are presented in Table 1. Our preliminary analysis used a variable-centered approach by assessing ethnic differences in means and change over time in the contact and importance dimensions. A 2 (time) × 3 (ethnicity) repeated measures analysis of variance (ANOVA) with contact as the dependent variable yielded significant effects for time, ethnicity, and the Time × Ethnicity interaction. There was a significant between-subjects effect for ethnicity, $F(2, 262) = 11.94$,

Table 1
Means and Standard Deviations for All Study Variables

	URM				White				Asian			
	Time 1		Time 2		Time 1		Time 2		Time 1		Time 2	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Contact with a matched mentor	3.15	1.20	3.43	1.12	4.01	0.92	3.99	0.87	3.29	1.24	3.67	1.10
Importance of having a matched mentor	2.99	0.85	3.06	0.90	2.65	0.84	2.61	0.87	3.11	1.04	3.08	1.07
Science self-efficacy	3.16	0.79	3.63	0.76	3.61	0.66	3.84	0.66	3.49	0.85	3.78	0.80
Identity as a science student	3.79	0.72	3.88	0.82	3.79	0.85	3.84	0.81	3.98	0.75	3.97	0.88
Commitment to a science career	4.03	0.80	4.12	0.93	4.03	0.87	4.05	0.86	4.16	0.80	4.16	0.89

Note. All variables were measured on a 5-point scale (1–5). URM = underrepresented ethnic minority students.

$p < .001$, $\eta_p^2 = .08$, with Tukey's HSD post hoc tests indicating that URM and Asian American adolescents reported significantly less contact than did White adolescents (M diff. = −0.71, $SE = 0.15$, $p < .001$ and M diff. = −0.52, $SE = 0.14$, $p = .001$, respectively). There was also a significant Time × Ethnicity interaction, $F(2, 262) = 4.37$, $p = .01$, $\eta_p^2 = .03$, such that URM and Asian American adolescents reported greater contact over time, whereas White adolescents remained stable.

The 2 (time) × 3 (ethnicity) repeated measures ANOVA with importance as the dependent variable revealed a between-subjects effect of ethnicity only, $F(2, 262) = 7.95$, $p < .001$, $\eta_p^2 = .06$. Tukey's tests indicated that URM and Asian American adolescents reported significantly greater importance than did White adolescents (M diff. = 0.39, $SE = 0.14$, $p = .01$ and M diff. = 0.46, $SE = 0.12$, $p = .001$, respectively).

Because the students may have been considering shared background in terms of SES or gender, we also conducted tests for whether contact and importance differed along these dimensions. We found differences in SES for contact, with students who received financial aid reporting significantly lower levels of contact than students who did not, $F(1, 263) = 35.36$, $p < .001$, $\eta_p^2 = .12$. There were no SES differences in importance and no gender differences in either contact or importance. Taken together, these analyses suggest that ethnicity was the primary aspect of the students' background they considered when making their assessments and that the significant SES finding is likely due to the overlap between ethnicity and SES in this sample.

In sum, the variable-centered analyses indicated that, on average, URM and Asian American students reported placing greater importance but having less contact with matched-background mentors than did White adolescents. Furthermore, during the course of the program the URM and Asian American adolescents reported an increase in having contact, but no change in importance. In our primary analysis reported next, we adopted a person-centered approach to understand individual differences in ratings of importance in relation to the degree of contact.

Mentoring Clusters

Our first step was to create mentoring typologies that considered the adolescents' perspective on how much contact they have had with mentors who share their background and how important such contact is to them. Thus, mentoring typologies were created at each time point by clustering ratings of (a) contact with matched-background mentors and (b) importance of having matched-background mentors. The questions pertained to any mentors they might have had; thus, the Time 1 clusters represent their perspectives based on preprogram mentoring experiences and Time 2 clusters include mentoring experiences they had through the program. We conducted the two cluster analyses using a two-step procedure (Hair & Black, 2000). First, we submitted the contact and importance scales to a hierarchical cluster analysis, using Ward's method of clustering and squared Euclidian distances to discriminate cluster centers. We hypothesized four clusters at each time point but examined a range of potential solutions due to lack of firm empirical guidance. The optimal cluster solution for each time point was selected by assessing a combination of the cluster distances reported in the dendrogram, the agglomeration schedule, and the cluster means. After selecting the preferred solution, we then conducted a *k*-means cluster analysis specifying the number of clusters and compared participant classification between the two methods. Congruent classification was high at both time points (82% at Time 1 and 88% at Time 2), suggesting that the solution was stable and reliable.

The findings for Time 1 indicated that a five-cluster solution was most appropriate (Figure 1). The clusters were identified as: high in both contact and importance (*High*; $N = 119$), moderate in both (*Moderate*; $N = 34$), low in both (*Low*; $N = 19$), high in importance but low on contact (*No Contact*; $N = 37$), and high in contact but low in importance (*Not Important*; $N = 58$). The clustering procedures for the Time 2 data indicated a four-cluster solution was most appropriate: High ($N = 104$), Moderate ($N = 49$), Low ($N = 19$), and Not Important ($N = 95$). Notably, the No Contact cluster was not evident at Time 2. The results from these cluster analyses support our proposal that there are individual differences in how students view the importance of having matched-background mentors in relation to how much exposure to such mentors they have actually had.

Variations in Clusters by Ethnicity, Gender, and Social Class

We next examined whether the mentoring clusters described earlier varied by ethnicity, social class, and gender. The Time 1 clusters varied significantly by ethnicity, $\chi^2(8) = 29.06$, $p < .001$, $v = .23$. URM students were most likely to be in the No

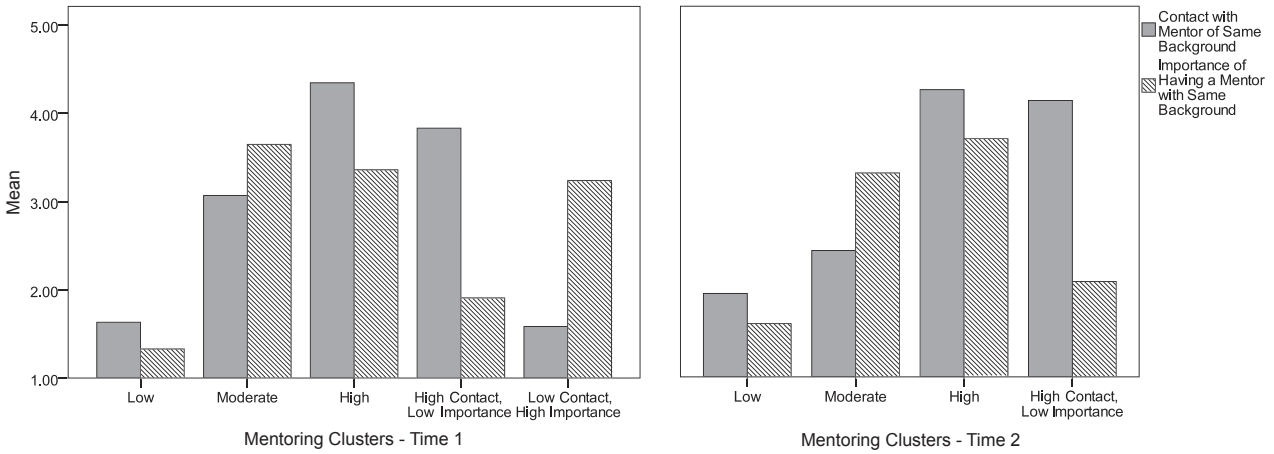

Figure 1. Mentoring clusters at Time 1 (left), in which a five-cluster solution was selected, and Time 2 (right), in which a four-cluster solution was selected.
Note. The difference between time points is that the ''Low Contact, High Importance'' cluster was only found at Time 1. ''High'' indicates high contact and high importance; ''Moderate'' indicates moderate contact and moderate importance; ''Low'' indicates low contact and low importance; ''Not Important'' indicates high contact and low importance; ''No Contact'' indicates low contact and high importance.

Contact cluster (i.e., reported high levels of importance but low levels of contact), whereas White students were more likely to be in the High or Not Important groups, with very few in the No Contact group. Interestingly, Asian American students were fairly evenly distributed across the five clusters, with slightly more in the Low group. Ethnic differences persisted at Time 2, $\chi^2(6) = 24.76$, $p < .001$, $v = .22$. URM students were least likely to be in the Not Important group and were slightly more likely to be in the Moderate or High groups. Asian American students showed a similar pattern, although they showed greater representation in the Low group than the Moderate group. White students were more likely to be in the Not Important group than any of the other three. There were no gender differences in cluster membership at Time 1 or Time 2. There were significant SES differences, and these differences mirrored the differences by ethnicity. These findings make sense in light of the previously reported analysis demonstrating the ethnic group differences in SES. Because we did not have the sample size to adequately test for both SES and ethnicity together, we proceeded with analyses based on ethnicity, but included SES as a control variable in the analyses of covariance (ANCOVAs) reported next.

Change in Cluster Membership Over Time: Five Pathways

The meaningful differences in the cluster solution between Time 1 and Time 2 and the ethnic differences in cluster membership point to the importance of mapping change in cluster membership over time. We conducted one-way chi-square analyses for each Time 1 cluster to determine if cluster membership at Time 1 was associated with movement into particular clusters at Time 2. If the omnibus chi-square were significant, we examined the residuals to determine what shift or shifts were accounting for the effect, as indicated by large positive residuals. These analyses indicated that each Time 1 cluster was associated with at least one Time 2 cluster. These significant changes over time were conceptualized as various *pathways*, which are named in parentheses following the description of the change:

- The Low cluster was most likely to remain Low, $\chi^2(3) = 10.68$, $p = .01$ (Stable Low).
- The Moderate cluster was most likely to increase to High, $\chi^2(3) = 23.65$, $p < .001$ (Increasing).
- The High cluster was most likely to remain High (Stable High) or shift to Not Important (Decreasing Importance), $\chi^2(3) = 89.17$, $p < .001$.
- The Not Important cluster was most likely to remain Not Important, $\chi^2(3) = 69.39$, $p < .001$ (Stable Low Importance).
- The No Contact cluster was most likely to shift to Moderate, $\chi^2(3) = 33.56$, $p < .001$ (Beginning Contact).

Of these six pathways, three represent stability over time and three represent change. Of course,

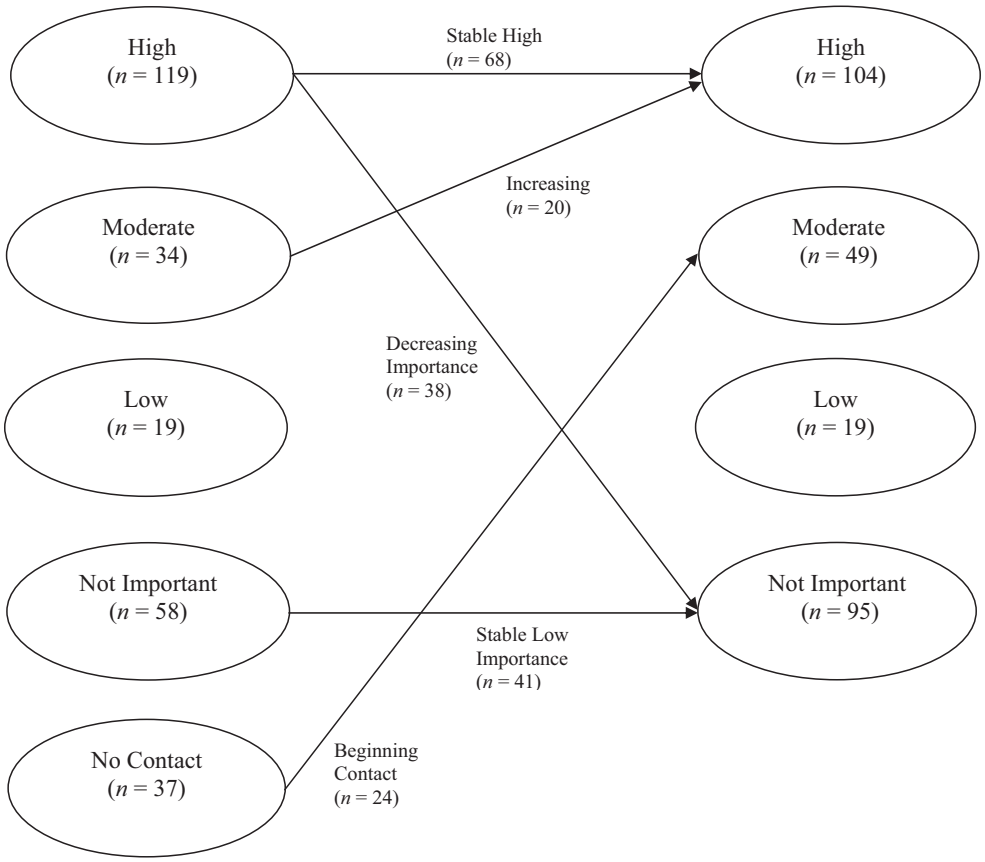

Figure 2. Mentoring clusters at Time 1 and Time 2.
Note. Paths shown and labeled were the most frequently occurring (capturing 72% of the sample) and were the ones used in subsequent analyses. The remaining 28% of the sample showed more idiosyncratic change (*N*s ≤ 10). ''High'' indicates high contact and high importance; ''Moderate'' indicates moderate contact and moderate importance; ''Low'' indicates low contact and low importance; ''Not Important'' indicates high contact and low importance; ''No Contact'' indicates low contact and high importance.

not all students followed the six paths described earlier; there were some who showed idiosyncratic movements that did not occur more or less frequently than would be expected. Unfortunately, the Stable Low path comprised a small number of students ($n = 10$), which precluded additional analysis. Thus, the analyses reported next focused only on the remaining five paths (Figure 2), which constitute adolescents who shifted over time in meaningful ways. These five pathways represent 72% of the sample ($n = 191$), and therefore capture the majority of adolescents.

Change in Cluster Membership Over Time, Moderated by Ethnicity, Social Class, and Gender

As with cluster membership, the distribution of ethnicity, $\chi^2(8) = 33.34$, $p < .001$, $\nu = .30$, and SES, $\chi^2(8) = 19.54$, $p = .001$, $\nu = .32$ among the five change pathways differed significantly, whereas they did not for gender. URM and lower SES students were more likely to be in the Increasing and Beginning Contact pathways, whereas White and higher SES students were more likely to be in the Decreasing Importance and Stable Low Importance pathways. Asian American students were more likely to be in the Stable High pathway than any other pathways. In other words, URM and lower SES students were more likely to have shifted to clusters representing moderate to high levels of both contact and importance, whereas White and higher SES students were more likely to move toward clusters characterized by low importance regardless of contact. Lastly, Asian American students were most likely to remain at high levels of both contact and importance.

Change in Cluster Membership Predicting Psychological Outcomes

We then examined how individual shifts in cluster membership over time corresponded with

changes in psychological constructs associated with pursuing a career in science. We ran three repeated measures ANCOVAs looking at whether change over time in science self-efficacy, identity, and commitment, in turn, varied by the five pathways. Due to sample size constraints, we were unable to test for moderation by ethnicity and SES, so these factors were included only as controls. For self-efficacy, there was a significant repeated measures effect, indicating a large increase in self-efficacy over time, $F(1, 183) = 70.70$, $p < .001$, $\eta_p^2 = .28$. We also found a significant main effect for cluster pathway, with the Beginning Contact group reporting significantly lower self-efficacy than the Stable High and Decreasing Importance groups, $F(4, 183) = 2.72$, $p = .02$, $\eta_p^2 = .06$. There was no Time × Cluster Path interaction, indicating that although all groups increased over time, the difference among groups remained stable.

For identity as a science student, there were no significant main effects (time or cluster path), but there was a significant Time × Cluster Path interaction, $F(4, 183) = 2.67$, $p = .03$, $\eta_p^2 = .06$ (Figure 3). Three of the groups increased: Stable High, Increasing, and Beginning Contact. By contrast, the Decreasing Importance group remained stable over time and the Stable Low Importance group decreased. In other words, students who shifted into clusters reflecting moderate to high importance *and* contact at Time 2 (mostly URM students) also increased in identity over time, whereas the students who felt having shared-background mentors was not important at Time 2 regardless of contact or Time 1 beliefs about importance (mostly White students) decreased or remained stable.

Lastly, for commitment to pursue a science career there was only a marginal between-subjects effect for cluster path, $F(4, 182) = 2.29$, $p = .09$, $\eta_p^2 = .04$. The Stable High group had significantly higher levels of commitment than the Stable Low Importance group. The main effect for time and the Time × Cluster Path interaction was not significant.

Discussion

The results of this study demonstrate the value of taking a person-centered approach to understand the role of having a matched-background mentor. Many often assume that ethnic minorities prefer to have mentors that share their background. Although our findings did support this notion, they

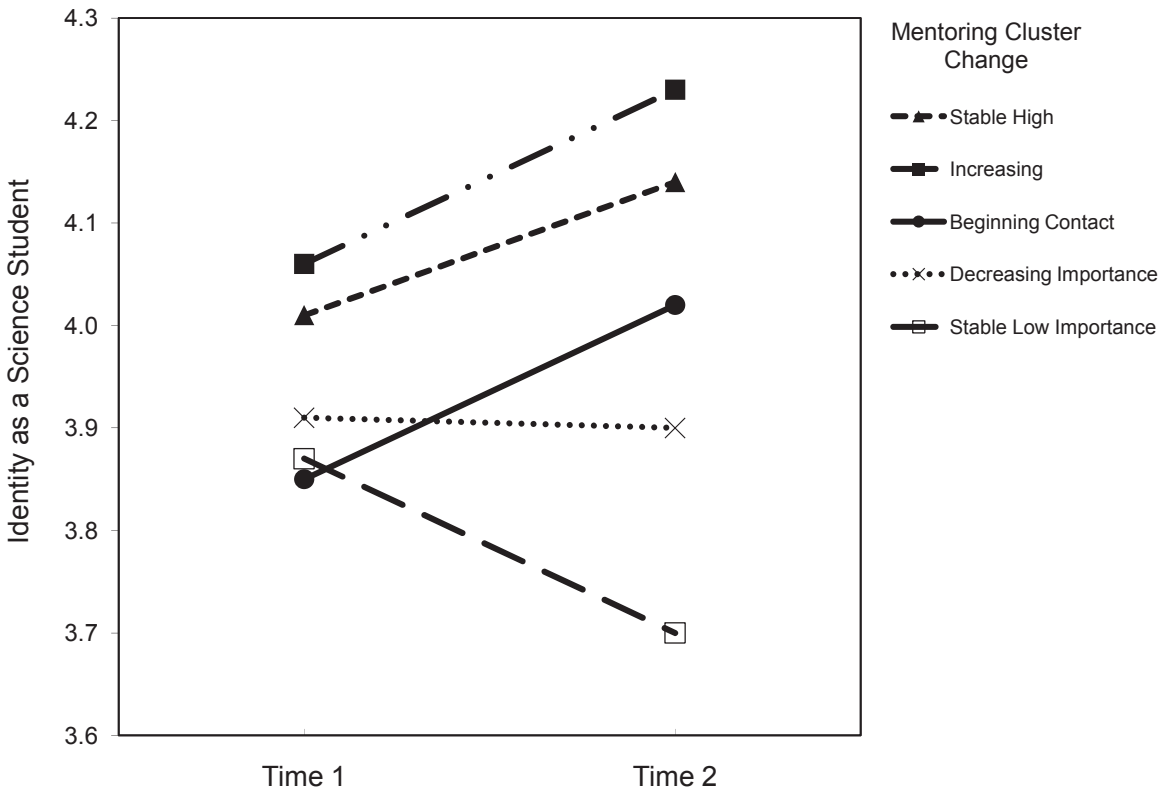

Figure 3. Change over time in identity as science student, as moderated by change in mentor clusters.

also revealed important individual differences. That is, shared mentor background is not important to all students from underrepresented backgrounds. Examining the frequency of contact with matched-background mentors as well as the personal importance of such contact is critical for future research to continue to understand the role of matched-background mentors for academic advancement, both in the context of STEM and more broadly.

The findings in this study suggest that a summer program can provide ethnically diverse adolescents with mentoring opportunities not previously available to them. The No Contact cluster that was evident at the beginning of the program was no longer apparent at the end of the program. This finding indicates that most students felt that they received mentoring from individuals who shared their background through the course of the program. Most notably among our findings, students who placed importance on having such mentors and reported that they received mentoring during the course of the program showed increases in their feelings of identity and belongingness as a science student, which is an essential component of committing to a career in science (Chemers et al., 2010; Erikson, 1968). This is an important finding, as these students tended to be from ethnic groups underrepresented in STEM fields. Seeing and interacting with successful figures enables adolescents to envision themselves in similar roles, thereby strengthening their identities (Markus & Nurius, 1986; Oyserman et al., 1995). Having a strong sense of identity as a science student may be particularly important for URM students given the immense barriers they experience to pursuing careers in STEM (Rochin & Mello, 2007; Solorzano & Ornelas, 2004).

An important question is whether the observed increases continue once the students return to their high schools. That is, is a brief but intensive experience enough to provide adolescents with the ability to envision themselves as scientists, or is more sustained mentorship needed? Future research would do well to answer this question. The summer program was an extremely supportive environment geared toward encouraging the students to become more involved with STEM and ultimately pursue a STEM related career. Unfortunately, the atmosphere of the summer program is not congruent with the general atmosphere in STEM undergraduate and graduate programs. It is not uncommon for students, particularly URM students, to feel like STEM programs are trying to weed out as many students as possible (Fouad et al., 2010; Syed, 2010). Indeed, the lack of belongingness felt by many students in STEM is what gave rise to the many support programs currently in place (Gándara & Maxwell-Jolly, 1999). It is possible this positive experience with STEM education earlier in their career will give the students hope and encouragement to persevere through the harder times that lie ahead. Alternatively, the youth may romanticize their positive experience and have unrealistic expectations of what the future holds, only to be disappointed by the very different atmosphere.

It is also important to recall that the present mentoring context was natural rather than formal. High school teachers are often cited as a key source of natural mentors; thus, the context of the present study, in some ways, more closely approximates how mentoring occurs in high school settings (DuBois & Silverthorn, 2005; Zimmerman et al., 2005). By contrast, mentoring at the college level occurs in a relatively more formal manner, with students working closely with faculty or graduate students in a research lab. In graduate school, the mentoring becomes much more formal, with most programs assigning graduate students to a specific faculty mentor. This changing mentoring context over time is important to keep in mind when interpreting the findings. The adolescents at the summer camp potentially developed mentoring relationships with faculty, graduate students, high school teachers, and residential staff, who served in both academic and socioemotional capacities. The more fluid and natural context of mentoring in the high school years would be valuable to explore in future work on this topic. One potential direction for future research is to examine the impact of matched-background mentors in the context of peer mentoring, which has been shown to be an effective practice (Karcher, 2005, 2008). Older, same-ethnicity peers may be more accessible to URM students in high school than are same-ethnicity teachers or other adults, and could potentially serve a similar identity-making function.

That the White adolescents placed less importance on having a matched-background mentor than the URM and Asian American adolescents is not surprising, as Whites are the dominant ethnic group in the United States and thus have the privilege of many available White mentors and role models. An interesting finding, however, is that the White adolescents tended to decrease in the importance dimension through the course of the program. This decrease might be due to the ethnically diverse context of the summer program. White adolescents may come into the program thinking that having White mentors is important because of

stereotypes they hold about the abilities of ethnic minorities, due in part to the dearth of ethnic minority science teachers in high school. However, in the context of the program they are exposed to and mentored by intelligent and capable individuals from many different ethnic backgrounds. Thus, they may come to see that ethnic minorities are just as capable of providing enriching experiences as are Whites, and therefore determine that shared background is not important. Consistent with this interpretation, those in the Decreasing Importance pathway, in which White adolescents were overrepresented, did not show any change over time in identity as a science student. Thus, for this group the changes in attitudes about having a matched mentor had little consequences in terms of identity, as the changes were not accompanied by changes in feelings of belonging in STEM.

The Asian American adolescents were more variable. Although they had similar ratings of importance and contact with mentors who share their background as URMs, their levels of self-efficacy, identity, and commitment were higher than URMs. Moreover, they showed no clear pattern of cluster membership or change over time. This pattern of findings could be due to the fact that Asian Americans, as a group, are overrepresented in STEM fields (National Science Foundation, 2010). Accordingly, they do not experience the same barriers to entry and persistence into STEM fields as do URM students. Thus, while they may be similar to URMs in their desires to have mentors that share their background, and may note the relative lack of availability of such mentors, having shared-background mentors does not seem to play as large of a role in instilling a sense of identity and belongingness in STEM.

There are, of course, other potential reasons for the observed pattern of findings for Asian Americans. Although Asian Americans as a group are considered well represented in STEM, it is really Asian American *males* that are well represented in STEM. This is in contrast to URMs in STEM, who more often tend to be women. Accordingly, there may be important gender differences within Asian Americans in their desire to have a matched mentor, particularly Asian American women seeking mentors who match that intersection of identities (cf. Azmitia, Syed, & Radmacher, 2008; Cole, 2009). Unfortunately, the sample size in the present study was too small to be able to conduct Ethnicity × Gender variations in cluster membership and change over time. However, examining the intersection of ethnicity and gender within all ethnic groups is an important direction for future research on STEM disparities. Similarly, in the present study ethnicity and SES were related, with URM students more likely to receive financial aid for the camp than White and Asian American students. Understanding the role of social class, and how it interacts with ethnicity in the context of mentoring, is another important next step in this line of research.

The determination that Asian Americans are well represented in STEM is based on the pan-ethnic grouping ''Asian American'' that subsumes a number of different ethnic groups. Accordingly, there may be important variations within Asian Americans to consider. Others have discussed the heterogeneity in national origins among Asian Americans that is associated with different histories of academic success, and that students from Southeast Asian backgrounds may be particularly susceptible to academic struggles (Bahrassa, Syed, Su, & Lee, 2011; Chang, Park, Lin, Poon, & Nakanishi, 2007; Ngo & Lee, 2007). Of course, the need to examine within-group heterogeneity extends beyond Asian Americans. In the present study, we classified students into three ethnic groupings—URM, Asian American, and White—because these three groups correspond to historical and contemporary disparities in STEM achievement and are aligned with how ethnicity is conceptualized for federally funded support programs. Nevertheless, there may be important variations within these groups to examine in the context of mentoring. For example, Chapa (2006) outlined how individuals of Mexican heritage make up nearly 60% of the U.S. Latino population yet only account for 25% of the U.S. Latino professoriate. By contrast, the representation rate of Central and South American professors is 2 to 5 times that of the corresponding U.S. population. A similar trend exists for African Americans, wherein African-born professors are overrepresented relative to American-born Black professors. This analysis raises questions about how similar or ''well-matched'' students really are with mentors who share their pan-ethnic background. A second-generation Mexican-heritage adolescent may have very little in common with a professor who was born, raised, and trained in Argentina, despite both being classified as Latino in the United States. Moreover, among Whites, those ethnic groups who were considered a separate racial group not long ago, such as the Irish and Italians (Hochschild, 2005), or recent European immigrants, may have stronger desires to have a matched-ethnic mentor than those who come from group who are better

established in the United States. Attending to nuances such as these, which simultaneously considers pan-ethnic and ethnic-specific matching, would be a valuable direction for future research.

Future Directions

Although this study was useful in highlighting the need to consider two dimensions pertaining to matched mentors, an important next step is to be able to predict these individual differences. What personal or contextual characteristics might be associated with a desire to have a matched mentor? There are several possibilities, but we feel that ethnic identity is a very strong candidate (cf. Darling, Bogat, Cavell, Murphy, & Sánchez, 2006). Ethnic identity refers to the degree to which individuals view ethnicity as an important part of who they are (Phinney, 1990). A reasonable hypothesis is that URMs with stronger ethnic identities would be more likely to place importance on having mentors who share their background. Indeed, this hypothesis derives support from findings in the therapeutic context that indicate that ethnic identity is a predictor of ethnic minorities' desire for a matched-background therapist (Coleman, Wampold, & Casali, 1995). It is quite possible that this finding will map on to the desire for a matched-background mentor.

It is important to note that the long-term importance of having a matched mentor is unknown. Other research on mentoring has documented that successful mentoring relationships are rooted in deep connections that move beyond demographic categories (Harrison, Price, & Bell, 1998). Yet it may be the case that having a mentor who shares one's background serves as an entrée—common ground—from which a deeper relationship can develop. The relative dearth of empirical research on matched-background mentors leaves many of these questions unanswered. Indeed, Rhodes et al.'s (2002) captured this sentiment by stating, ''Arguments for and against matching on the basis of race in mentoring programs have become, to some degree, ideological premises that are based on beliefs rather than research'' (p. 2115). We believe our study contributes to this much-needed research base while attending to some of the important nuances that future researchers should consider. Indeed, the findings in the present study have broad implications for mentoring relationships beyond the STEM context. Future research in a variety of contexts—industrial, organizational, and therapeutic settings to name a few—would do well to consider the role of individuals' preferences for mentors from particular backgrounds for mentoring processes and outcomes.

In closing, we must consider the unique nature of the sample. The adolescents in this study were very high achieving—the top students in their schools—and were clearly committed to involvement in STEM on account of attending the summer program. Although this fact may lead some to believe that we do not need to worry about these students, such a conclusion would be misguided. Academic success and career intentions in high school are no guarantee of persistence in STEM in college (Syed, 2010). Indeed, research on the deleterious effect of stereotype threat, for example, has documented that it is the highest achieving students that may be the most at risk (Good, Aronson, & Harder, 2008; Steele, 1997). These are students that absolutely should not leak out of the pipeline. But they do, and we need to think hard and act purposefully to keep it from happening.

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