

# Mentoring Perceptions and Experiences of Minority Students Participating in Summer Research Opportunity Programs

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## Abstract

Literature has documented the underrepresentation of minority students in higher education and the importance of mentoring programs in retaining these students in the academy. This study examines the perceptions of mentoring and actual mentoring experiences of minority students participating in two Summer Research Opportunity Programs (SROPs) at Iowa State University. Seven mentoring functions (Clarity of Project, Challenging Assignment, Training, Contact, Assistance, Feedback and Role Modeling) were identified through the literature as being important in the mentoring relationship. Findings indicated that the students' mentoring experience was better than expected, but students also noted that mentors should devote more attention to the Clarity of Project, Training, Contact and Role Modeling functions. The findings of this study reinforce the importance of mentoring in SROPs. Implications for practice and recommendations for future research are also discussed.

## Introduction

A major component of many Summer Research Opportunity Programs (SROPs) is the role of mentors (Gaffney, 1995; Kinkead, 2003). Under the guidance of a mentor, undergraduate research is seen as a scholarly activity that helps to promote scientific

inquiry, experiential learning, scholarship, career development among other functions (Kinkead, 2003). Currently more attention is being paid to the mentoring that takes place for undergraduates as a way to recruit and increase retention levels of minority students in various fields; and as a tool of enrichment of the overall undergraduate experience (Jacobi, 1991).

Mentoring is a key component of most SROPs, especially programs that are aimed at increasing the presence of women and minority students in, science, technology, engineering, agriculture, and mathematics (STEAM) fields. Historically, women and minority students have not been exposed to STEAM fields as the choice of a major in college, and as a career to pursue upon graduation (Gale, 2002; Lease, 2004). There is substantial underrepresentation of minority students in STEAM and other technical fields which can be attributed to several factors, one being the lack of mentors that minority students see in these fields where traditionally there has been little representation of minorities (Gale, 2002; Lease, 2004). The majority of students that participate in SROPs happen to be students from minority serving institutions, and it is through SROPs that these students are exposed to more educational and career opportunities that they otherwise might not have known existed (Crawford et al., 1996). Because of the low rate at which minority students enter graduate school and pursue advanced

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degrees, several authors have examined the impact of mentoring on their educational and career goals (see Crawford et al., 1996; Tenenbaum et al., 2001; Thomas et al., 2007). These studies have documented an increase in retention and persistence among minority students to pursue advanced degrees, and remain in the academy when mentoring is made available to them as compared to students who may not have had a mentor (Crawford et al., 1996). Several benefits have been attributed to the mentoring of undergraduates including the enhancement of the educational experience and providing guidance related to career options (Chopin, 2002; Lopatto, 2007). Undergraduates who have an opportunity to participate in research with a faculty mentor are able to take the theory that they have learned or read about and put it into practice, as well as to reflect on the positive and negative aspects of the experience. Through this process, students are able to “do science,” which entails being able to understand a research problem and determining what is needed to address the problem (Kardash, 2000).

Lease (2004) suggests that African Americans and other minority students usually have less information about educational and vocational options because they may not have been exposed to these opportunities, or had a mentor or role model to guide them in that process. Because of the lack of knowledge that these groups possess regarding various careers, mentoring is vital to the students’ professional development (Thomas et al., 2007). The mentoring function in SROPs serves to guide the minority students that participate in them in an exploration of careers, and providing a “road map” to these careers through mentoring, and various activities that coordinators may plan for students (Lopatto, 2004). It is through the mentoring process that students are able to begin developing a career path as to what they may want to do with their lives upon graduating from their undergraduate institution. Career development has a broader meaning outside of solely choosing an occupation, and extends also into furthering educational goals. The interaction experienced with a mentor during a undergraduate research experience is extremely vital in the decision making process of deciding to stay in a particular field as an occupation, or to pursue graduate studies in a field (Crawford et al., 1996; Haring, 1999; Lopatto, 2007). The idea of the mentoring process through these experiences is that the student and mentor will develop a relationship where the student can go to the mentor for advice, and possibly model the career path of the mentor.

For this study, the researchers examined two SROPs at Iowa State University (ISU). Currently

there are two SROPs at ISU that aim to increase the presence of minority students in the STEAM fields. First, the George Washington Carver Internship Program (GWCIP) works to increase the presence of minority students in the agricultural and life science fields, while the Alliance for Graduate Education and the Professoriate (AGEP) which is funded through the National Science Foundation (NSF) aims to increase the minority presence in the science, technology, engineering and mathematic fields. Both of these SROPs utilize a mentor/student pairing process to acclimate students to the various research settings. In both of these SROPs, students work on research projects under the guidance of a faculty mentor to produce a project that is presented at a closing symposium.

There is a particular urgency in higher education to increase the number of minority students receiving advanced degrees (Foertsch et al., 2000), and to avoid further attrition of minority students, the federal government as well as institutions of higher education are promoting a wide array of programs aimed at recruiting and retaining these students in academia (Campbell and Campbell, 1997; Jacobi, 1991). It is through the mentoring process in SROPs undergraduate students are being prepared for a future in academia, a career in their chosen discipline, or for graduate school. To date there have been few attempts to understand the perceptions and experiences of minority students participating in SROPs.

Even with governmental and institutional support of SROPs there has been little research examining the mentoring experience of minority students. Furthermore, there has been practically no research done to empirically establish various functions that should be practiced throughout the course of an undergraduate research mentoring relationship. As such, the overall goal of this study was to better understand the experiences minority students had while participating in an SROP so that improved mentoring practices could be implemented by program coordinators.

## Conceptual Framework

Several studies have addressed the phenomena of mentoring, detailing various benefits, perceptions, experiences, and expectations of participating in undergraduate research (Bauer and Bennett, 2003; Lopatto, 2004; Nnadozie et al., 2001; Russell et al., 2007). However, few studies have empirically identified functions of a quality mentoring experience. Wunsch (1994) stated that “mentoring is a set of behaviors that can be defined, learned and practiced”

(p.30). Based on a comprehensive review of the literature seven mentoring functions were identified which have been shown to be important in SROPs. These functions come from the work of Brzoska et al. (1987) who identified six functions essential to mentoring and Jacobi (1991) who after a review of mentoring literature identified 15 functions from various mentoring studies. Many of the functions that Brzoska cited were also cited by Jacobi, although there was one function that Jacobi cited that Brzoska did not include in his mentoring model. Isiyama (2007) provided two classifications where the mentoring functions are derived. The first of these classifications structure identifies functions of the mentoring and research experience “that contribute to the structures of the research problem or process” (p.541). The structure functions include: Clarity of Project, Challenging Assignment, and Training. The second classification of functions includes Consideration which “contributes to the emotional and social needs of the student” (p.541). The Consideration functions include: Contact, Assistance, Feedback and Role Modeling. Figure 1 provides an illustrative framework depicting the relationship between mentoring and the seven mentoring functions.

Clarity of Project is providing the student with clear and concise information as to which research project he or she will be working on. This should be done to ensure that the student and the mentor know what research activities will be performed. Often, students arrive on campus for their SROP experience with limited knowledge with many having no idea of the details of their research project. Some mentors

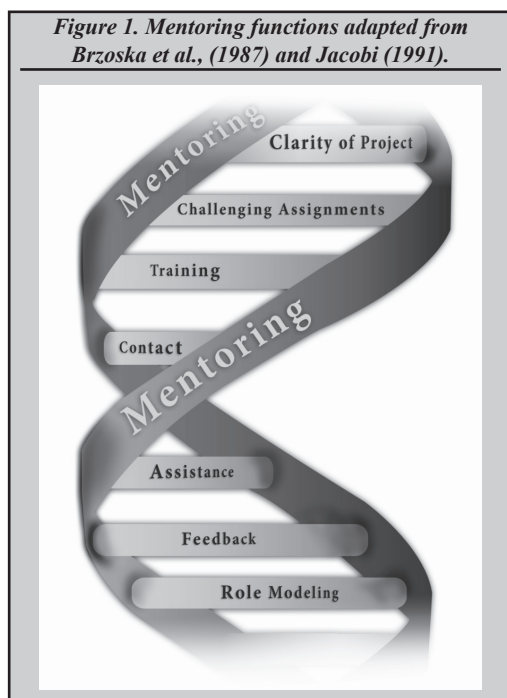
may have more than one student working in their lab during the summer, so it is important for the mentor to have the various projects that students are working on clarified. Providing a clear idea of what research is to be conducted will allow for a better match of mentor and student.

Challenging Assignments include providing the student with a task that adds to their knowledge base and skill set. Challenging Assignments are necessary because often a student may be engaged in an activity that doesn't contribute to the intellectual growth of the student. The assignment should not be impossible, but challenge the student so that they make intellectual gains (Kardash, 2000). Students are taking part in this experience to prove to themselves that they can conduct research and to see if the possibility of graduate school or a life of research is for them (Lopatto, 2004).

Training is providing the student with any technical or specialty training that he or she receives toward the completion of the research project. This function is important because many students who participate in SROPs may have little to no experience of being in a lab or research environment (Kardash, 2000). If students are working on a project in their field of study, the training they receive shows them how theory is practiced. Gonzalez (2001) suggests that “the primary mission of the research university is not merely carrying out research but training students to do research” (p.1624). The training mentors engage in with a student will be more than just technical training. Some students may come from an institution that does not emphasize research. In this instance, the mentor will have to train the student how to perform a review of literature and other skills that are associated with scientific writing.

Contact includes the interaction that occurs between the mentor and student. The contact that a student has with his or her mentor is very important to the success of the project and mentor relationship. The Contact function consists of two sub-functions. The first sub-function is formal contact and the second is informal contact. Both types of contact help develop the bond that the mentor and student have. Formal contact can be described as contact that takes place between a mentor and a student in a structured environment. Informal contact takes place outside of the structured environment of the lab, such as during lunch, or if the mentor invites the student to his or her house for dinner (Wolfe, 2006). These interactions between the mentor and student are vital to the success of the project and to the success of the mentoring relationship.

Assistance is providing the necessary help that a student may need in completing a research



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project. The Assistance that is given to students in a mentoring relationship is in the form of direct or indirect assistance as well as through advice. Often, a student has more indirect assistance rather than direct assistance because in some settings the mentor may not be available to the student at all times. Often, a graduate student, lab assistant or post-doc will work more closely with the student and approach the faculty mentor when a problem has been encountered that he or she are not able to answer. Some level of direct assistance is needed even if it is just a brief meeting to check on the progress being made on the project by the student.

Feedback is a three step process which should include a pre-conference, observation, and post-observation conference (Brzoska et al., 1987). The feedback that a student receives from his or her mentor is vital to the success to the project (Wolfe, 2006). If a mentor is not providing feedback at key times of the project, several negative outcomes may occur in the relationship between the mentor and student. For example, the student may believe that he or she are headed in the right direction with the research, but come to find out the mentor may want to pursue other research goals.

Role Modeling in research settings should consist of helping the student develop professionally (Davidson and Foster-Johnson, 2001; Wolfe, 2006). The overall concept of Role Modeling is to show the student the quality traits of a good researcher. For example, if the project results in a manuscript that is suitable for publication, the mentor should help the student identify which journal the study would best fit in and help him or her prepare it for submission.

### Purpose

The purpose of this study was to explore the mentoring perceptions and experiences of Summer Research Opportunity Program participants. The specific objectives of this study were to:

1. Identify the mentoring experiences of Summer Research Opportunity Program participants.
2. Identify the extent to which the seven mentoring functions were practiced by mentors in Summer Research Opportunity Programs.

### Methods

#### Participants

The population of this study was comprised of students who participated in either the George Washington Carver Internship Program (GWCIP) (n=34) or the Alliance for Graduate Education and the Professoriate (AGEP) (n=44) at Iowa State

University during the summers of 2006 thru 2008. The final sample consisted of 26 (68%) females and 12 (32%) males. Thirty (79%) of respondents identified themselves as African American or Black; 4 (10%) identified themselves as Latin/Hispanic; 2 (5%) identified themselves as Asian/Pacific Islander; 1 (3%) was Native American/American Indian and 1 (3%) identified themselves as 'other'. Twenty-three (60%) of the students indicated they participated in the AGEP, while 15 (40%) of the students participated in the GWCIP. Thirty-two (89%) of the students identified themselves as having a major in a STEAM disciplines (e.g. computer science, agricultural education, biology, electrical engineering, etc.), while four (11%) students majored in non-STEAM majors (e.g. physical education, human sciences, education).

### Research Procedures

This study used a descriptive survey design. Iowa State University's Institutional Review Board approved the study protocol and all participants provided informed consent prior to participation in the study. The researcher used SurveyMonkey to collect data, and track respondents and non-respondents. Data were collected using the five contact steps recommended for achieving high response rates (Dillman, 2000) which included: 1) a pre-notice email, 2) the questionnaire, 3) a thank you note/reminder email, 4) replacement questionnaire and 5) a final contact. Seventy-eight questionnaires were emailed with 42 of the students responding for a response rate of 54%. The questionnaire used for this study was adapted from several studies that have measured the perceptions of the mentoring process and the satisfaction level of the mentoring process. After a review of relevant mentoring literature, instruments used by Allen (1997), Gale (2002), Lopatto (2004), and Wolfe (2006) were modified for use in this study. Participants were asked to select the most appropriate response from multiple choice or fill-in-blank items. To assess validity, the instrument was given to a panel of experts that included three faculty members from a Department of Agricultural Education and Studies at ISU. Cronbach's alpha was used to assess the questionnaire for reliability. Internal consistency reliabilities for the perceptions of mentoring and personal mentoring experiences sections of the questionnaire were .97 and .95 respectively. The first section of the questionnaire focused on identifying the student's initial perceptions of mentoring. This section consisted of 37 statements that assessed the extent to which the student believed selected mentoring functions should be practiced. This section utilized a four-point Likert-



type scale ranging from (1= strongly disagree to 4= strongly agree). Section two focused on the actual mentoring experience of the student and to what extent selected mentoring functions were practiced. Similar to section one, 37 statements were used to measure the mentoring experiences and the extent to which the mentoring functions were practiced. Section two utilized a four-point Likert-type scale ranging from (1= strongly disagree to 4= strongly agree). Section two had four additional questions that also measured how the mentoring functions were practiced. These four questions were multiple-choice in nature. The questionnaire also utilized open-ended questions used by Allen (1997) that were modified to ascertain the students' level satisfaction with the mentoring program.

Because the participants of this study represented a specialized population no sampling techniques were used (Gale, 2002). Descriptive statistics including frequencies, means, percentages, and standard deviations were used to describe the extent to which mentoring functions were being practiced by mentors. Paired t-test analyses were used to compare the students' initial perception of mentoring with that of their actual mentoring experience.

**Results**

**Objective 1:** Identify the mentoring experiences of Summer Research Opportunity Participants.

Students were asked to rate their mentoring experience with a majority (76% collectively) indicating that their experience was much better than expected (Table 1). Students were also asked to rate their overall mentoring experience. Collectively, 73% of the students rated their mentoring experience as positive to very positive (Table 2).

**Objective 2:** Identify the extent mentoring functions practiced by mentors in the Summer Research Opportunity Programs. Students were asked to identify the extent they agreed with statements measuring selected mentoring functions. The functions of interest included: Clarity of Project, Challenging Assignment, Training, Contact, Assistance, Feedback, and Role Modeling. The challenging Assignment function had the highest mean value (M= 3.57, SD= .52) while the Training function had the lowest mean value (M= 3.12, SD= .47) (Table 3). Students were also asked to indicate the extent they agreed with statements measuring the

**Table 1. Students Rating of their Mentoring Experience (N=42)**

The mentoring experience.....		
Response	f	%
Was worse than I expected	2	5
Was a little worse than expected	7	19
Met my expectations	10	27
Was a little better than I expected	4	11
Was much better than I expected	14	38
Total	37	100

<sup>1</sup>Note. Not all responses equal 42 due to non-respondents.

**Table 2. Students Overall Rating of Mentoring Experience (N=42)**

Response	f	%
Very negative	2	5
Negative	1	3
Neutral	7	19
Positive	11	30
Very positive	16	43
Total	37	100

<sup>1</sup>Note. Not all responses equal 42 due to non-respondents.

mentoring functions during their SROP experience. The Challenging Assignment function had the highest mean value (M= 3.37, SD= .60) while the Training function had the lowest mean value (M= 2.77, SD= .67) (Table 4). A paired sample t-test was conducted to compare the means of the mentoring functions (Table 5). The mean differences for each function were all significant (p<.05) indicating a difference between a students' initial perception of mentoring and the actual mentoring that took place. Cohen's d was calculated to determine the magnitude of the mean difference. The observed effect sizes ranged from .61 to 1.58 indicating a medium to strong effect size. Both of these observed effect sizes indicate that the differences were practically significant.

**Discussion**

For this study, we sought to explore the mentoring perceptions and experiences of SROP participants. We

**Table 3. Means and Standard Deviations of the Perception of Mentoring Functions (N=42)**

Mentoring Function	n	M	SD
Clarity of Project	42	3.28	.59
Challenging Assignment	40	3.57	.52
Training	40	3.12	.47
Contact	42	3.48	.63
Assistance	41	3.36	.52
Feedback	41	3.39	.53
Role Modeling	39	3.34	.68

<sup>1</sup>Note. Not all responses equal 42 due to non-respondents.

Scale: 1= Strongly Disagree, 2= Disagree, 3= Agree, and 4= Strongly Agree

**Table 4. Means and Standard Deviations of Extent Mentoring Functions Were Practiced With Students (N=42)**

Mentoring Function	n	M	SD
Clarity of Project	36	2.80	.50
Challenging Assignment	37	3.37	.60
Training	35	2.77	.67
Contact	36	2.95	.51
Assistance	37	3.08	.64
Feedback	35	3.04	.74
Role Modeling	38	2.90	.75

<sup>1</sup>Note. Not all responses equal 42 due to non-respondents.

Scale: 1= Strongly Disagree, 2= Disagree, 3= Agree, and 4= Strongly Agree

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*Table 5. Paired Samples T-test Results between Students' Perceived and Experienced Functions (N=42)*

Mentoring Function	N	M	SD	t	d
Clarity of Project-Perception	36	3.42	.37	7.54*	1.41
Clarity of Project-Experience	36	2.80	.50		
Challenging Assignment-Perception	37	3.67	.35	3.31*	.61
Challenging Assignment-Experience	37	3.37	.61		
Training-Perception	34	3.22	.39	3.50*	.86
Training-Experience	34	2.75	.67		
Contact-Perception	36	3.62	.30	7.34*	1.58
Contact-Experience	36	2.96	.52		
Assistance-Perception	37	3.46	.35	4.26*	.74
Assistance-Experience	37	3.08	.64		
Feedback-Perception	35	3.49	.35	3.71*	.76
Feedback-Experience	35	3.05	.74		
Role Modeling-Perception	36	3.49	.39	5.47*	1.03
Role Modeling-Experience	36	2.87	.76		

<sup>1</sup>Note. Not all responses equal 42 due to non-respondents.

<sup>2</sup>\* $P=0.05$

found that a majority of the SROP participants rated their mentoring experience as positive and meeting or exceeding their expectations which supports the work of Lopatto (2007) who also found that the mentoring relationship plays an important role in the undergraduate research experience. This finding is important because it implies that the mentors were engaged with their students and provided a positive mentoring experience included offered psychosocial (e.g., psychological or social support) and instrumental support (e.g., professional and career advice) (Davidson and Johnson, 2001). At the undergraduate level, this type of information is critical in helping students prepare and apply for graduate school and ultimately determining whether or not minority students continue in the STE[A]M pathway (NRC, 2011). Not only did the SROP participants indicate that they perceived Challenging Assignments as the most important mentoring function but they also indicated that this mentoring function was actually being practiced by their mentors. This finding suggests that the SROP participants want to be given Challenging Assignments, in addition to the fact that their mentors were providing them with assignments that challenge them throughout the course of the research experience. The notion of providing challenging work assignments is also important in helping to prepare minority students for the rigors of STEAM majors and careers.

There were also differences between the students' initial perception of mentoring and the actual mentoring that took place across all of mentoring functions. The largest differences observed between the students' initial perception and the extent to which the mentoring functions were being practiced occurred among Clarity of Project, Contact, and Role Modeling. To clarify, Clarity of Project involves providing the student with clear and concise information as to which research project they will be working on and should be done to

ensure that the mentor and student are in agreement on what will be done during the project. Contact refers to the number and level of interaction that occurs between the mentor and student. The interactions experienced by the student and mentor are vital to the success of the project and to the success of the mentoring relationship. Finally, Role Modeling consists of helping the student to develop a professional identity. In this study, SROP participants perceived that these functions should be practiced, however, the extent to which they were practiced by the mentor occurred less often. Interestingly, the functions identified based on the largest differences

between the students' initial perception of mentoring and the actual mentoring that took place support what Jacobi (1991) refers to as the foundational elements of mentoring which include: 1) emotional and psychological support, 2) direct assistance with career and professional development, and 3) role modeling.

### Limitations

Our findings should be considered in light of the study's limitations. First, is the issue of generalizability. This study had a relatively small sample size, additionally; students were not randomly selected to participate in the SROP programs. Another limitation is the lack of a diverse sample of minority students. A majority of our sample was comprised of African-American students and thus would have been enhanced if a larger sample of students from other racial and ethnic groups were included. Finally, the instrument that was used to assess the perceptions and satisfaction levels of the mentoring process were adapted from other survey measures. Hence, the lack of previously established validity and reliability estimates leads to the possibility of introducing the threat of measurement error.

### Implications for Practice

The findings of this study have implications for improving the mentoring process of minority undergraduate research interns. Our findings point to the promise of the seven-mentoring function as one approach of helping to facilitate the mentoring of minority students participating in SROPs. Because of the differences that were observed between the students' initial perception of mentoring and the actual mentoring that took place; it may benefit program coordinators of SROPs to explain the role and importance of the seven mentoring functions during

mentor orientations in order to ensure that mentors provide the best possible mentoring experience to their students. Also implied is the idea that SROP coordinators should encourage mentors and students to develop a formal agreement that would outline what should be expected from both the mentor and student. This will allow both parties to understand what should occur throughout the mentoring relationship which introduces another level of accountability. Further implied from the findings is the notion that SROP coordinators in concert with the mentors should develop a standard definition of mentoring that is tied closely to the seven mentoring functions which could also be used to guide the mentoring relationship. Taken together, these improvements to the mentoring process may have a positive impact on the mentoring relationship (Wolfe, 2008).

### Recommendations for Future Research

The findings of this research point to several important directions for future research related to the mentoring of minority undergraduate research interns. First, a study should be conducted using the seven-function mentoring questionnaire with mentors of other SROP programs to assess their perception of mentoring and the extent that the seven mentoring functions identified in this study are practiced. A study of this nature would provide information that could be used to identify gaps in current mentoring practices. This information could also be used as baseline data to help refine the current mentoring practices being used by SROP programs. Second, a qualitative study should be conducted to obtain a more rich understanding of the extent to which mentors are practicing the seven mentoring functions as well as to examine how the mentoring in SROPs could be enhanced from the student's perspective. This would provide a more in-depth understanding of the student's mentoring experience, which would ultimately help enhance the mentoring relationship. A study should also be conducted comparing mentors who have been trained to use the seven mentoring functions with mentors who have not been trained to use this approach. This approach would allow researchers to better assess the efficacy of the seven-function mentoring model with minority students participating in SROPs. Finally, although many types of undergraduate research experiences fuel interest in STE[A]M careers and higher degrees (Russell et al., 2007), another area of research to explore would be to assess the long-term impact of the seven-function mentoring model on minority students' persistence in STEAM majors and careers.

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