The Spend a Summer with a Scientist Program: An evaluation of program outcomes and the essential elements for success

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Abstract

A third-party evaluation of the Spend a Summer with a Scientist (SaS) program at Rice University established the effectiveness of this summer research and professional development program with respect to the recruitment of minority undergraduates into graduate school and the retention of minority graduate students at Rice University. Tracking of student academic outcomes, and interviews and surveys with student participants demonstrated not only that SaS participants are enrolling in graduate school and obtaining graduate degrees at an unusually high rate, but that most of these participants feel the program had a powerful impact on their decisions about and success in pursuing advanced degrees. A number of them asserted that they would not have completed their degrees—or thought to enroll in graduate school at all—had it not been for their participation in the Summer with a Scientist program. For undergraduate participants who have since graduated, 63% went on to enroll in graduate school, while 33% gained employment in mathematics, computational science, or engineering. For graduate student participants, the rate of retention so far is 97%, with just one student having left graduate school without a degree. A total of 57% of these participants are still in graduate school making steady progress toward their degrees, and of those who have already graduated with advanced degrees, two-thirds have received Ph.D.s. Quantitative and qualitative analyses of survey and interview data were used to identify the essential elements that were critical in bringing about the success of the SaS program. To facilitate the replication of this program at other institutions, this report delineates what characteristics of the program director, the student community, and the research project would likely have to be present in order to bring about similar outcomes in other institutional and departmental contexts.

Table of Contents

1. Introduction

1.1. Statement of the problem

One of the most vexing problems in higher education has been the dramatic underrepresentation of African Americans, Hispanics, and American Indians among advanced degree holders, especially in the areas of science, mathematics, engineering, and technology. Despite two decades of effort to address this shortage, it remains the case that few minority students enroll in graduate programs, and even fewer go on to complete their graduate degrees (Manger, 1996; Manzo, 1994; Massey, 1992; Phillip, 1993). While about 30% of Whites with a Bachelor of Science degree go on to graduate school, only about 19% of minorities with a B.S. do the same (Massey, 1992). And by 1995, African Americans still made up only 4.7% of the total number of Ph.D. recipients, Hispanics only 3.3%, and American Indians 0.5% (Manger, 1996). By comparison, African Americans currently make up about 12% of the U.S. population, Hispanics 10.2%, and American Indians 0.7% (U.S. Bureau of the Census, 1995).

Numerous programs at the national and institutional level have attempted to address this problem by encouraging more minority students to enroll in graduate school. Active recruitment strategies that many graduate schools have tried include minority graduate fellowships, recruitment trips to minority colleges and all-expenses-paid campus visits, phone calls and letters from minority alumni, and summer undergraduate research programs (Wagener, 1991). Most schools have little information on the effectiveness of their recruitment strategies and even less information on *how* these strategies accomplish or fail to accomplish their objectives (Malany, 1987; Twale, Douvanis, & Sekula, 1992). However, an evaluation of the summer undergraduate research programs at Big Ten universities like the University of Wisconsin-Madison's found that programs which bring groups of minority students to an esteemed research university for the summer to work with dedicated faculty mentors and their graduate students on a structured research project not only encourage a high percentage of these students to pursue graduate degrees but also bring a high percentage of those minority participants back to the institution sponsoring the program (Foertsch & Alexander, 1997). In the case of the UW-Madison, its summer undergraduate research programs encouraged 42% of minority participants to enroll in graduate school, 60% of whom came back to the UW-Madison for their degrees.

Of course, recruiting minority students to enroll in graduate school addresses only part of the problem. The next challenge is keeping them enrolled long enough to obtain their graduate degrees. Many universities, if they explicitly address the problem at all, do so through isolated, non-programmatic strategies like minority graduate fellowships, minority graduate student social clubs, or seminars that provide orientation for students in or about to enter their first year of graduate school. Programmatic efforts to address the problem of minority graduate student retention are less common, but models for apparently successful programs at the graduate level do exist (McDavis, Molden, & Wilson, 1989; Olson, 1988; Phillip, 1993). Strategies that have been deemed important to the success of some of these programs include: (1) reliable financial support for participants, with fellowships being the most common means of support but teaching and research assistantships being the most successful at integrating recipients into their departments; (2) opportunities for minority graduate students to do research with and be mentored by faculty, particularly minority faculty where available; (3) opportunities for minority graduate students to participate in a student community and to serve as mentors to minority undergraduates; (4) summer courses or seminars that allow students with weaker academic backgrounds to gain necessary content knowledge and skills; and (5) providing orientation

and professional development training for incoming students. It stands to reason that the more of these elements that a graduate retention program incorporates, the greater its likelihood for success.

1.2. Description of the Spend a Summer with a Scientist (SaS) program

The Spend a Summer with a Scientist (SaS) program sponsored by the Center for Research in Parallel Computation (CRPC) at Rice University is a program that addresses both the recruitment *and* the retention of minority graduate students, particularly those in applied mathematics, the computational sciences, and engineering. The SaS Program was created in 1989 by Dr. Richard Tapia, a nationally-esteemed professor of applied mathematics and the CRPC's Director of Education and Human Resources, who administers the program with the help of senior graduate student participants. The ultimate goal of the SaS program is to increase the number of ethnic minorities and women in mathematics, the computational sciences, and engineering. From about 1989 until 1992, the program director recruited minority undergraduates from around the country (but primarily from Texas) to spend the summer doing research with a faculty member at Rice University. The intent of this experience was to introduce them to research in an academic setting and give them confidence in their research skills, thereby encouraging them to attend graduate school. In subsequent years, the program shifted its focus to also address the retention of minority graduate students already attending Rice. Hence, what was initially just a summer undergraduate research program shifted to become a unique multi-ethnic summer research community that includes Rice University graduate students as well as undergraduates from around the country. Beginning in 1995, white female participants were also added to the program. In addition to its unusual mix of undergraduate and graduate student participants, this program is different from many summer research programs in that it encourages students to participate for multiple years. This allows participants to move from their undergraduate careers to their graduate student careers while remaining within the same supportive research community. It also allows participants who are in the program for multiple years to not only be mentored by older students but to become mentors themselves as they progress.

While the demographics of the participants have changed over the years, the structure of the SaS program has remained essentially the same. Students are given summer financial support to participate in a research project under a mentor/advisor who is a faculty member at Rice University. The research topic, degree of difficulty, and amount of structure associated with this project are adjusted to suit each student's needs, whether they are a graduate student completing dissertation research or an underclassman from a small college who has never done research before. Students who need to catch up on their requirements or prepare for upcoming courses may also have a program tailored to meet that need. Participants generally give an accounting of their activities at the end of the summer, either through a written report or a presentation. For minority graduate students in the Computational and Applied Mathematics (CAAM) department at Rice, participation in this program is mandatory.

There is a significant community aspect to the Summer with a Scientist program. New participants from off-campus are recruited and given practical assistance by the Rice graduate students already in the program, and participants see each other often during the course of the summer, both formally and informally. Every Friday, the entire group of SaS participants attends an afternoon seminar with the program director to discuss issues of research and professional development, race and gender, and problems or issues that have come up during the week. This weekly get-together is viewed as an opportunity to get to know and respect the other participants and to learn about what it means to be

an academic, a researcher, and a minority in one's field. The program also includes an outreach component: participants serve as mentors to two groups of high school students for two weeks during the summer, and they give presentations of their research to K-12 teachers who attend a CRPC-sponsored summer workshop.

1.3. The goals of the SaS program and the strategies for achieving them

Interviews with the program director and analyses of the program literature revealed that the Summer with a Scientist (SaS) program has explicit goals that are specifically linked to strategies for achieving them. There are five intermediate goals that are meant to support the ultimate goal of increasing the number of women and minorities in mathematics, the computational sciences, and engineering. These supporting goals, the reasoning behind those goals, and the strategies for achieving them are listed below:

The Ultimate Goal: To increase number of women and minorities in mathematics, computational science, and engineering by influencing them to pursue graduate degrees.

Supporting Goal #1: Developing a community matrix

An underlying tenet of the program is that minority students are more likely to be retained if they feel they are part of a community that both supports and relies on them. Hence, one of the key supporting goals in the SaS program is to develop a community web or "matrix" that surrounds students with caring people and with opportunities to both give and receive assistance. This community matrix has several components:

- *Students must be part of a minority student community:* In order to counteract the isolation that many minority and female students feel in a predominantly white male graduate environment, the program administrators created a community of peers in which students could feel a sense of welcoming, belonging, and comfort. *Strategy*: The Friday afternoon group meetings give SaS participants time to meet, socialize, and talk about issues that are important to them. Because students participate for multiple years, the community has time to develop and grow; for the graduate students, this community remains in place throughout the school year.

- *Students must be enculturated into the professional research community:* The program director feels that it is important to openly enculturate students into the graduate school and research communities, since many have little knowledge of the unspoken rules and customs of those cultures and limited interaction with the people that do. *Strategies:* The Friday meetings with the program director give participants an opportunity to discuss academic and professional codes of conduct and the special issue of being a minority within these cultures. The program director also attempts to introduce his students into these communities by taking them to research conferences. Finally, the program director serves as an advocate for the SaS graduate students throughout their careers at Rice. He continues to act as a mentor to many former participants long after they have received their degrees.

- *Students must remain linked to communities outside the academy:* SaS program administrators feel that in order to counteract minority students' feelings that they have disappointed or turned

their backs on their community, minority students should be given the opportunity to reach out to people from similar backgrounds outside of the academy. *Strategy:* To achieve this goal, participants in the SaS program mentor high school students from two high schools for two weeks in the summer and give workshop presentations to K-12 teachers who teach minority students in their math and computer courses.

Supporting Goal #2: Getting students involved in productive research

One of the main goals of the program is to teach participants about academic research careers by getting them involved in a productive research project with a well-established faculty researcher. For graduate participants, this summer project often leads toward their dissertation or Master's thesis. The underlying assumption of the program is that doing research gives participants a sense of accomplishment and an indication that they are proceeding in graduate school. *Strategy:* Students work with a faculty advisor and/or graduate assistants throughout the summer on a research project. They are expected to have a high-quality product at the end of the summer.

Supporting Goal #3: Professional development

Graduate students and aspiring graduate students often need instruction and practice in how to present their research and how to debate academic topics in a constructive and collegial manner. *Strategies:* During the Friday seminars, the program director instructs students in how to be clear in presenting their research and how to appear professional in their demeanor and dress. To practice what they have learned, students prepare and present talks about their research and attend talks given by others.

Supporting Goal #4: Financial support

The program director feels it is essential to financially support students during the summer so that they can spend their time productively on research and professional development rather than working in unrelated jobs. *Strategies:* Undergraduates in the SaS program get $1000/month for three months; graduate students get $1500/month for three months. Participants may also apply for funding to attend conferences.

Supporting Goal #5: Academic support

The SaS program provides some participants with time to supplement their academic preparation. According to the program director, minorities who come from small colleges may not have the coursework they need to succeed initially at Rice. If they are to persist and live up to their ultimate potential as graduate students, some students need time to study and fill in the gaps in their knowledge. *Strategy:* The SaS program gives some participants, particularly those making the transition from college to graduate school, financial support while preparing for the fall semester. Their preparatory studies are conducted under the guidance of the program director.

2. The Goals and Methodology of the Evaluation

In the summer of 1997, the Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center was commissioned by the National Partnership for Advanced Computational Infrastructure (NPACI) to evaluate the Summer with a Scientist program in the hopes that the lessons learned could be applied to similar programs throughout the United States. As a result, a LEAD evaluation team was formed to conduct a year-long evaluation of the SaS program and another CRPC-sponsored outreach program known as GirlTECH. The primary interest of the client for the SaS evaluation, Dr. Richard Tapia, was to determine whether the SaS program could be replicated at other institutions so that the impact of this presumably successful minority recruitment and retention program could be broadened to a national scale. To answer this question, it is first necessary to determine whether the program is indeed successful at achieving its ultimate goal of increasing the number of women and minorities who enroll in and complete graduate school in mathematics, the computational sciences, or engineering. Next, one must determine which program elements are essential to its successful outcomes. Finally, if the essential elements are not found at, or cannot readily be established at other universities, it suggests that the program will be difficult to replicate elsewhere.

To address these unknowns, the LEAD research team spent a year investigating what happens in the SaS program and the impact of the program on the different types of students who participate in it. The study sought to find answers to the following research questions:

- What actually takes place in the program?
- How do graduate students experience the program; how do undergraduate students experience the program?
- Does the program help mitigate the feelings isolation that minorities can feel on a majority campus? If it does, how is that achieved?
- Do students who participate in the program feel more confident in their ability to succeed in graduate school and more interested in doing so?
- For undergraduates, does the program increase understanding of their research area and the type of research done in the academic world? Does this understanding lead to an increased interest in research and/or a career in the major?
- Does the program increase undergraduates' understanding of the graduate environment? Does this understanding lead to an increased interest and/or enrollment in graduate school?
- For graduate students, how does the program deal with issues of integration into the department and/or disciplinary culture? Does the program help the student form a support network with other graduate students…with faculty advisors?
- Does the program help graduate students in developing the professional skills needed to succeed?
- How does the program assist graduate students in making academic progress toward their degree, if at all? Does the program influence success in course work, passing qualifying exams, progressing on thesis work?
- Some time after leaving the program, what do participants perceive its impact to be?
- What are the essential elements of the program in producing positive outcomes? Do the essential elements differ for undergraduate and graduate student participants?

To answer the research questions about the impact of the SaS program on its participants, the LEAD research team collected data from a number of different sources using both qualitative and quantitative research methods. In July of 1997, two LEAD researchers traveled to Rice University to observe the 1997 SaS program in progress, to interview current participants individually and in two

focus groups, and to interview program administrators and staff about their goals and experiences with the program. The trip lasted for 4 days, during which 4 program administrators including the program director were interviewed, 3 graduate student participants were interviewed individually, 7 graduate student participants were interviewed as part of one focus group, and 3 undergraduate and 3 beginning graduate student participants were interviewed as part of another focus group. These research activities provided a base of information about the program and allowed the interview protocols for student participants to be piloted and refined.

To answer the question of whether the program is successful at its primary goal of encouraging minority and female participants to enroll in graduate school and complete their graduate degrees, it was necessary to track previous participants in the program to see what they had done in the years since leaving the program. What percentage of undergraduate participants went on to enroll in graduate school? What percentage of graduate participants were still enrolled in graduate school and making satisfactory progress toward their degrees? What percentage of graduate participants had already obtained advanced degrees? Gathering information about these outcomes is complicated by the fact that the program is national in scope and many participants do not leave contact information with Rice when they move on to another school or leave school altogether. Also, since no program records were available from 1989 and 1990, we could only track SaS participants from the last 7 years of the program. Beginning in October of 1997 and continuing through April of 1998, researchers at the LEAD Center worked with SaS staff members to obtain outcome information on 52 of the 68 former and current SaS participants since 1991. These individuals were then contacted by phone or by email to determine what degrees they had received and when; what graduate schools, if any, they had attended; what their future degree plans were; and what they were doing now in terms of schooling and employment. This tracking information was used to determine the basic program outcomes pertaining to graduate degree pursuit and attainment.

Of course, even if a high percentage of SaS participants go on to enroll in graduate school and/or obtain graduate degrees, these satisfactory outcomes cannot be ascribed to the influence of the SaS program alone without further research. It could be that many of the program participants would have enrolled in graduate school and persisted long enough to obtain their degrees whether they had participated in the program or not. To determine the impact of the program itself, it is necessary to do one of two things: (1) find a comparatively-sized group of minority students at the same or a very similar institution who had not participated in the program and compare their graduate school enrollment and degree attainment to that of SaS participants; or (2) interview and survey SaS program participants about the impact of the program on their beliefs and attitudes about graduate school, their motivation to pursue graduate degrees, and their overall ability to do so. The first option could not be pursued in this case, since all minority graduate students in mathematics and the computational sciences at Rice are already enrolled in the SaS program and Rice's environment in unique enough and its percentage of minority graduate students high enough that an equivalent but "non-treated" control group at another institution could not reasonably be constructed. Hence, LEAD researchers used interviews and surveys of current and former SaS participants to determine what the impact of the program on them had been.

The interviews of current and former SaS participants began with the pilot individual interviews and focus groups conducted in July and continued with additional individual interviews conducted by phone in November and December of 1997. In all, 11 people who had participated as undergraduates only, 9 people who had participated as graduate students only, and 5 people who had participated

both as undergraduates and graduates were interviewed in sessions lasting from 40 minutes to 2 hours. With the participants' permission, the interviews were tape-recorded and transcribed. They were then analyzed and synthesized using inductive qualitative analysis methods. These interviews provided in-depth information about program participants' backgrounds, educational experiences, and aspirations; their experiences being recruited into, participating in, and in some cases, administering the SaS program; and their perceptions of the intellectual, academic, emotional, and practical impact of the SaS program on them, their current life trajectory, and their future plans. The three researchers who conducted interviews referred to one of four written protocols that contained open-ended questions and were trained to follow up on questions or ask new questions as needed. An example of an interview protocol may be seen in Appendix A.

In December of 1997, 38-question surveys were sent to all 52 former and current SaS program participants who could be contacted in order to check the statistical reliability of the information we had gathered through interviews and to collect additional information about how participants rated and evaluated certain aspects of the program. In all, 29 participants returned completed surveys by the time of our statistical analysis, for a response rate of 56%. Twenty-two of these surveyed individuals were also among the 25 individuals we interviewed. Hence, our conclusions about the student experience in the program are based on feedback from a total of 32 separate student participants (47% of all participants since 1991). A copy of the survey may be seen in Appendix B.

3. Outcomes from the Tracking Data for Undergraduates and Graduates

Overall, 68 students have participated in the Summer with a Scientist program since records were first kept in 1991, the vast majority of whom were majors in mathematics, computational science, and engineering, although some other physical science and social science majors have also participated. These participants have included Hispanic and African-American undergraduates from around the country and Hispanic and African-American graduate students from Rice University. Since 1995, 8 white females have participated in the program as well. The race and gender of SaS participants is in Table 1; their educational status while participating in the program is in Table 2.

Table 1: Participants by race and gender

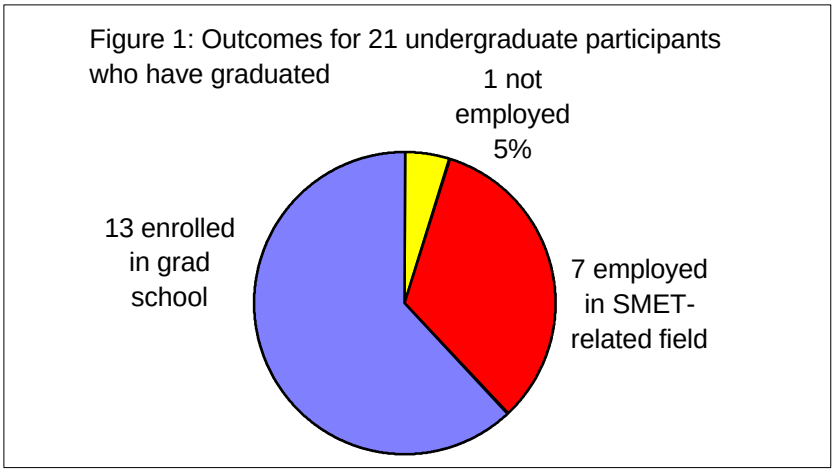
Race	Female	Male	**Total**	**%**
Hispanic	15	18	33	48%
African-American	15	12	27	40%
Caucasian	8	0	8	12%
Total	38	30	68	100%
%	56%	44%	100%	

Table 2: Participants by educational status

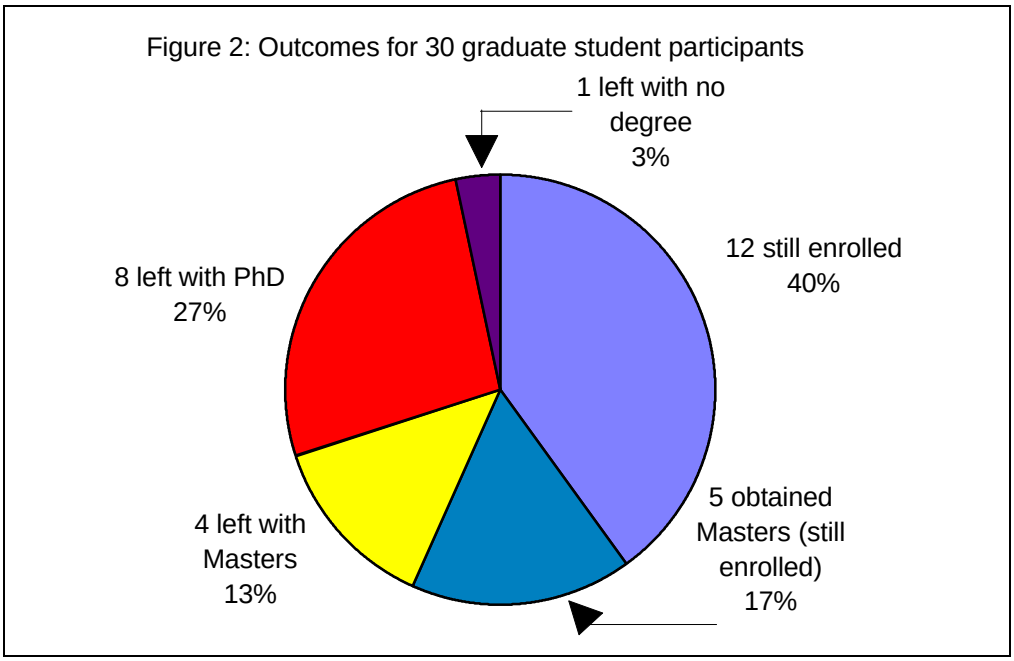
	Total	**%**
Participated only as an undergraduate	36	53%
Participated as an undergraduate and a graduate	8	12%
Participated only as a graduate student	24	35%
Total	68	100%

In all, outcome information was available for 52 of the program participants: 22 whose only participation had been as undergraduates, and 30 who had participated as graduate students (5 of whom participated as undergraduates as well). The 16 students for whom no outcome information was available included 14 undergraduate participants (8 from 1991 alone) whose status after graduating from their academic institutions was unknown. The two graduate students who could not be tracked were a math major from 1992 and a biology major from 1994. (These two students are no longer at Rice but it was unclear whether they had transferred to other graduate institutions or had stopped pursuing their degrees altogether.) In all, the pool of "untrackables" included 9 males and 7 females; 9 African Americans and 7 Hispanics.

For the undergraduate participants, the main goal of the program is to encourage as many as possible to complete their baccalaureate degrees and advance to graduate school. For those who do not enroll in graduate school, it is hoped they will find employment in an area related to mathematics, computational science, or engineering so that they may serve as minority representatives and role models in industrial, corporate, and university settings. Figure 1 shows the outcomes for the 21 undergraduate participants who had already graduated and had the opportunity to make a choice about graduate school. As one can see, almost two-thirds of these participants enrolled in graduate school, while another third gained employment in mathematics, computational science, or engineering. By comparison, according to the Baccalaureate & Beyond Longitudinal Survey done by the National Center for Educational Statistics, less than 9% of African Americans and Hispanics who received baccalaureate degrees from 1992-1993 have gone on to enroll in graduate schools and, based on the data from other ethnicities, the percentage is presumed to be even lower for those with baccalaureate degrees in mathematics, computer science, and engineering.



For the graduate student participants, the main goal of the SaS program is to retain them in graduate school until they receive an advanced degree, preferably a Ph.D. Figure 1 shows the outcomes for the 30 graduate student participants who we were able to track. The rate of retention so far is 97%, with just one student having left graduate school without a degree. A total of 17 (57%) of these participants are still in graduate school making steady progress toward their degrees, and of those 12 who have already graduated with advanced degrees, two-thirds have received Ph.D.s.



Clearly, SaS program participants are enrolled and retained in graduate school at much higher rates than is the case with the typical minority (or non-minority) student in mathematics, computational science, or engineering. The effect of the program itself on these high enrollment and retention rates is explored in the section that follows.

4. Essential Elements for Success: How and Why the Summer with a Scientist Program Works

Although tracking the graduate school enrollment and advanced degree attainment of past and current participants in the SaS program allowed us to determine the extent to which the program's ultimate goal was being met, it is unclear from these numbers alone what the impact of the program itself was on participants' decisions to attend or remain in graduate school. Interviews and surveys of past and current participants were used to determine the perceived impact of the program on their readiness for, decisions about, feelings about, and success in pursuing graduate degrees. These two data sources were consistent in demonstrating that the Summer with a Scientist program had a significant and powerful influence on the choice to attend or remain in graduate school for the vast majority of students who participated in it. As seen in Table 3, 89% of the 27 participants who responded to this survey question said that the program increased their desire to attend or remain in graduate school, with 15 saying that the program increased their desire "greatly," and 10 saying it increased "somewhat." Only 2 of the participants' surveyed felt the program had no impact on their preexisting feelings about whether or not to attend or remain in graduate school.

Table 3: Program impact on surveyed participants' desire to attend or remain in graduate school

Change in desire to attend/remain in grad school	Count	%
Increased greatly	15	59%
Increased somewhat	10	30%
No change	2	7%
Decreased somewhat	0	0%
Decreased greatly	0	0%

Similarly, many of the 25 program participants we interviewed said the SaS program had been a major factor in convincing them to enroll in or remain in graduate school. All six of the interviewees who had participated as undergraduates and had since gone on to graduate school said the SaS program was the deciding factor in their decision to attend graduate school. Another undergraduate participant who had yet to graduate remarked, "Since I've been in this program, this is honestly the first time I've ever really been motivated to pursue graduate studies. I'm thinking about it. I might not do it, but it's definitely an interest that keeps growing." One of the interviewees had never even thought of himself as having the potential to enroll in graduate school until he participated in the program and was convinced by his experiences in the program that he had what it takes to succeed as a graduate student. When asked what parts of the program had influenced him in deciding to go to graduate school, he replied:

> Well, I think it wasn't so much anything explicit that I experienced—it was more of a general thing about the program. I think just the fact that these people who I'd never met before in my life could relate to me…One of the major things is that Dr. Tapia and [my advisor] had confidence that I could do it, that I can make it in grad school. I think that if I didn't have that, I wouldn't have decided to come. If I got the least bit of perception that they really didn't believe that I can make it, then I probably wouldn't have gone through with it. But there were a lot of other things also that convinced me. I mean, just research and how it's done, how it's conducted. The type of students—I got to meet a lot of the students. I realized that…my background's a lot different than them, but that as people, we're pretty much the same. And we had interests in similar things. I was able to talk to them. With a lot of my friends back home, I'm doing the talking…I go off on all these philosophical ideas and they can't relate to what I'm talking about…But here, it's totally different. Here, people respond. They interact and they talk about these things, and when we have meetings, everybody has something intelligent to say about everything from… philosophical issues and society values and professionalism, to sensitivity and race, to scientific things.

The program also had a powerful influence in convincing a number of graduate student interviewees to remain in graduate school when the going got tough and their reasons for continuing were in question. As one such graduate student asserted:

> My commitment to graduate school was definitely affected by my participation [in the SaS program]…I mean, I think had I not been in the summer program, had my SaS advisor and had Tapia not been there, I literally would have left my second year, with no Master's, no nothing…It connected me with people…who supported me.

Survey respondents were also asked more specifically about which parts of the program influenced their decisions to attend or remain in graduate school. Table 4 shows how surveyed participants responded when asked to rate on a 5-point scale how different program activities affected their desire to attend or remain in graduate school. The activities are listed in order from those with the greatest positive influence to those with the least influence. The three most influential activities in increasing participants' desire to attend or remain in graduate school were: interactions with the program director, being in the company of other minority students, and the interactions with the other students in the program. All nine of the activities listed caused some degree of increase in the desire to attend graduate school for at least half of the participants surveyed.

Table 4: Impact of various program activities on surveyed participants' desire to attend or remain in graduate school

Program activities	Decreased greatly	Decreased somewhat	No change	Increased somewhat	Increased greatly	Increased (% of 27)
Interactions with the program director	0	0	3	8	**16**	89%
Being in the company of other minority students	0	0	3	**13**	11	89%

Interactions with other students in the program	0	1	3	**12**	11	85%
Interactions with the research project mentor/advisor	0	2	6	7	**13**	79%
Friday discussions about professional development	0	1	5	**12**	10	79%
Friday discussions about race and minority status	0	0	7	**13**	7	74%
Doing research in a university setting	1	1	5	6	**13**	73%
Giving presentations on one's research	0	1	**11**	5	9	54%
Mentoring minority high school students	1	1	**11**	10	3	50%

The SaS program has other impacts beyond encouraging participants to attend or remain in graduate school. According to interviewees and survey respondents alike, participation in the program created the feeling of belonging to a community, increased their feelings of preparedness for graduate school, and increased their feelings of preparedness for a career. Furthermore, the program increased most participants' confidence in both their skills and their chances for success in their degrees and careers (see Table 5). Decreases in confidence due to some activities (most notably, doing research) were seen for 3 of the 27 participants surveyed.

Table 5: Impact of the SaS program on surveyed participants' confidence levels

Confidence in…	Decreased greatly	Decreased somewhat	No change	Increased somewhat	Increased greatly	Increased (%)
Giving presentations and talks	0	0	2	6	**18**	92%
Succeeding in their career	0	0	3	8	**16**	89%
Completing their degree	0	0	6	5	**16**	85%
Discussing controversial topics in a constructive way	0	0	4	9	**14**	85%
Mentoring other students	0	1	3	10	**13**	85%
Doing research	1	2	2	10	**12**	81%
Approaching and interacting with faculty	0	1	5	**11**	10	78%
Getting into graduate school	0	0	**11**	8	7	58%

In the sections that follow, evidence from both the interviews and the surveys will be brought to bear on the question of *how* the SaS program produced these desirable effects. By performing an integrated analysis of the qualitative and quantitative data, we were able to derive hypotheses about the essential elements of each of the three critical structures in the Summer with a Scientist program: the program director that administers and sustains the program, the community of fellow minorities that surrounds students in the program, and the research project that is the focus of the participants' summer training. In the three sections that follow, we will discuss what factors critically define each of these structures and how each of these structures contributes to the success of the program overall.

4.1. Essential elements of the program director

The role of the program director in the success of the SaS program is an important one. As seen in Table 4, 89% of survey respondents said their interactions with the program director increased their

desire to attend or remain in graduate school—59% "greatly" and 30% "somewhat." Because it is the program director's and NPACI's desire to see this program replicated elsewhere—and with directors other than Dr. Tapia at the helm—it is necessary to determine which of the program director's personal, situational, and background characteristics and which of his program-related activities have contributed to the remarkable success of the program at Rice. Once these characteristics and behaviors are explicitly identified, they can be sought and encouraged in those who wish to direct similarly successful programs at other institutions.

Our analyses determined that there are six characteristics of the SaS program director that are essential to the demonstrated success of the SaS program at Rice University. In brief, the program director helps to make this program a success because he:

A) functions as a role model for the students as a successful and respected researcher from a similar background who has maintained his ethnic identity
B) is esteemed by his colleagues yet still approachable
C) supports and encourages students through individual mentoring relationships and builds their confidence to pursue and persist in graduate degrees
D) serves as a guide to the academic world by providing professional development information and opportunities to participants
E) has influence and "clout" within the university that enables him to actively support students' academic and financial interests
F) creates and actively sustains the SaS community

In the paragraphs that follow, we describe each of these essential elements in more detail so that the reader may understand how and why they contribute to the positive outcomes of the Summer with a Scientist program.

A. The program director functions as a role model for the students because he is a successful and respected researcher from a similar background who has maintained his ethnic identity.

In surveys and interviews, the students discussed the personal and professional background of the program director and the qualities that were important to them in this person. It was important to many students that the program director was someone that they could admire and respect, but also that he had a background with which they could identify. Both of these factors were critical to the director's ability to function as a role model for these students. According to the results of our survey of SaS participants, 89% of the respondents believe it is important that the program be led or significantly contributed to by a respected professor who is a minority, with 59% saying it was "critical," and another 30% saying it was "very important, though not critical." Only 1 of the 27 respondents said that having the program led or contributed to by a respected minority professor was of little or no importance.

Similarly, most of the program participants we interviewed discussed how important it was to have a role model showing them it was possible for minority students like them to achieve their academic and career goals. A number of these students were quite cognizant of the fact that they had not followed the traditional pathway to academia and felt they needed a model like Dr. Tapia to illustrate to them that it was indeed possible for someone from an alternative path to achieve success as a scholar and researcher. In discussions with SaS participants, most emphasized that it was particularly important

that their role model had come from a similar ethnic or social class background. They needed to see an academic who had encountered struggles similar to their own—someone for whom climbing the academic ladder had not come easily—in order to believe that they, too, could succeed. As one such student remarked:

> One of the things that really choked me was when [Dr. Tapia] told me that he started in community college. So it was like, wow! I was really surprised. And from there I just thought, "Okay, if he did it, I can do it." It doesn't mean anything that I'm in a community college and it doesn't mean that I've ignored anything and that I'm not as smart!

Even for graduate students whose path through higher education had been relatively smooth, Dr. Tapia's rise to success was inspiring:

> Dr. Tapia, he's just an amazing guy…just being exposed to a minority who is obviously successful and who had come up the ranks. You know, this wasn't someone who was handed his achievements on a silver platter…I seem to recall that he worked really hard and he was very good. He went to junior college, as a matter of fact. So just sort of seeing that, it's like, "Oh, okay. You can get up there." The portrayal of successful minority role models was good for me…I had always done fairly well, but it's always good to see, "Oh, okay. Someone's done it." You know, there's a path there.

Another essential factor that enabled ethnic minority students to view the program director as a role model was that he had fully maintained his ethnic identity while achieving in the academic world. In our interviews, SaS participants found it remarkable that a person could be a successful academician and still maintain their ethnic or racial sense of self. Many students coming into the program had held the underlying belief that to succeed as academics they would have to eschew their ethnic roots—to become like the mostly white, mostly male academics around them. But Tapia's own example helped them discard that belief. Many of the interviewees discussed how having a role model that had not given up his ethnic identity to be a mathematician was encouraging to them and played an important role in motivating them to continue on their current academic pathways:

> Tapia was able succeed in a mainstream profession…but at the same time, when you go to his home, he's still an approachable Latino male. It's good to know you can maintain your sense-of-self and still be successful in academia. That's really important to me. You can have a family, and it's okay. I mean, there was this great picture of him in an article they did on him, and he's standing there with a star and a cowboy hat. You can still be Chicano and be good at math. And I think that was hugely important, and I think it's something that he *strived* to do. It's the fate of this Chicano kid from the barrio to like math, and I think it would have been very easy for him to give up that earlier part of his identity if he wanted to. But instead, he strived to maintain that identity.
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> *********
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> We talked about…the different cultures. Mathematicians have a stereotype of being sort of antisocial and a little nerdy, and many really are. They really are. It's not so much that they're racist or anything, it's just that they're such a concentrated, different enclave unto themselves, different from the general masses in this country. So it seems a little bit more difficult for someone like me to try to integrate into that. But…you have this whole other animal, the minority mathematician…You see Dr. Tapia interact with these [more stereotypical mathematicians] and never lose sight of his personality or whatever his culture brings to the table. So he's sort of encouraging for us. You don't have to completely lose who you are to integrate into a mathematical complex.

Because of the program director's continued ties to his minority culture and ethnic roots, minority students in the SaS program feel comfortable talking to him about issues and problems related to ethnicity—more comfortable than they would be if he were not a minority himself. Some of the interviewees were specifically asked whether the director of a program like SaS needed to be a minority. Although a few interviewees felt the important thing was that their program director was

from a “non-traditional” or “alternative” background, the majority felt that his status as an ethnic minority contributed to his value as a mentor and a resource. As one interviewee who held the latter opinion explained:

> I think it’s important for the program director to be an ethnic minority. The question arises in the following context: SaS has begun to incorporate anglo women in the past year or two. And within typical arguments for minority anything…the anglo women will take a decision opposite the ethnic population. And so it becomes important that we get across the whole concept of what it is to be an ethnic minority. I think most women will assume that an ethnic woman will affiliate herself first on the basis of gender. But that’s untrue. She will always associate herself with her ethnicity first, and then with her gender…That’s from my own experience and conversations I’ve had with various peers. And when you can’t even imagine that because you’ve never thought of yourself in terms of ethnicity, when you tend to see yourself as just a woman without ever having to consider the ethnic part, you’re gonna attack problems in professional development completely differently, because you don’t know where a [minority] person’s coming from. So, I do think it’s important to have the ethnicity aspect of the [director] come in, because these are gonna be issues that we have to deal with at various levels of our careers.

Finding appropriate role models is often particularly difficult for minority graduate students, and this is one reason that many leave the academic pipeline before having completed their advanced degrees (Smith & Davidson, 1992; Turner & Thompson, 1993). Our interview analyses suggested that the SaS program provides its ethnic minority participants with an ideal faculty role model in the person of its director, Dr. Tapia, and as a result, many come to feel less alienated and less anomalous in the predominantly-white academic culture they face at Rice University and elsewhere. Through his own example, the program director illustrates to minority students and students from alternative academic backgrounds that they, like him, can succeed as scholars, and that they *belong* at an esteemed academic institution like Rice. A cogent final example comes from a Hispanic student who entered the program with a less-than-stellar academic background. This student was encouraged by the similarities in his and the program director’s backgrounds to pursue a graduate degree at Rice, something he had never seen as possible before. In describing his previous mind-set about his academic potential, the power of having a minority role model becomes clear:

> Sometimes I still can’t believe I'm at Rice. You know? My mom and I, we would just talk about this place. It was the place that we’d never lay a foot on, this campus, because it was way beyond any of our reach. And I can't ever think of a moment that a friend of mine would say, "Yeah, I'm going to Rice"…Rice was never even mentioned. It was just understood that this was a place that we didn't belong…But Dr. Tapia made me believe I could do this…I don't think [other faculty] here understands the type of person that comes from the environment that I've come from…And I think Dr. Tapia does. I know he does…He was there himself.

B. The program director is esteemed by his colleagues yet still approachable

While the program director’s alternative career path and his ethnic minority status made him more compelling as a role model for the minority students in the SaS program, it was his inclusive and relational manner that drew many students into the program in the first place and made them feel comfortable enough to develop a mentoring relationship with him. In our analyses of participant interviews, it became clear that many of the interviewees would not have entered the program at all, or gained as much from their participation, had it not been for the approachability and warmth of the program director. Having a “world-famous mathematician” talk to them like a colleague or old friend made program participants feel respected and valued in his eyes and hence increased their self-esteem

and confidence. When a focus group of SaS participants was asked what it was about the program director that made them want to have him as a mentor, they said the following:

> R1: He cares. He's compassionate. But at the same time, he has like, he has everything else you can think of too. He's a successful mathematician, he's up there in the national committees. He gets the honors, but he's still very compassionate.
>
> R2: He's very down-to-earth, he likes talking with you on a level that you don't feel he's talking down to you.
>
> R1: Like he's talking *with* you. And like I mentioned earlier, that's what really [stood out] when I first met him. He had just been nominated to NAE, then here I'm talking to him, and I just never expected him to talk like that, you know? Like, "Oh yeah, I went there too." And then it was like we were friends or something, like we had known each other before.

Numerous interviewees emphasized that this combination of successfulness and approachability was an essential quality for a program director. One student, when asked if they thought the program could be replicated at other universities, said the following:

> It will work with another director like [Dr. Tapia]. It would need sort of the respected minority faculty member, but one who's approachable. I mean, there's two kinds of minority faculty members, those who are approachable and those who aren't. So it couldn't just be, "Here's our biggest name." It would have to be [a famous mathematician], who's brilliant: People look up to him, but at the same time, he's so approachable.

C. The program director supports and encourages students through individual mentoring relationships and builds their confidence to pursue and persist in graduate degrees

Research has shown that relationships with faculty and mentors are the single most important factor in graduate students successfully completing their graduate degrees (Arce & Manning, 1984; Blackwell, 1987; Hartnett, 1976). Unfortunately, studies on graduate student performance and retention have found that minority graduate students encounter far greater difficulties establishing relationships with faculty members than is the case with white graduate students (Allen et al, 1984; Clewell, 1987; Hall & Allen, 1983; Nettles,1990; Turner & Thompson, 1993; Carrington & Sedlacek, 1976). Part of the problem may be that faculty members have the tendency to pick as protégés those students who most resemble themselves in terms of gender, ethnicity, and social background characteristic. As a result, many minority students are overlooked by white faculty members looking to "develop someone in their own image," and the predominantly white, male faculty tends to perpetuate itself (Blackwell, 1989).

The SaS program directly attempts to address these problems faced by minority graduate students through the mentorship provided by the program director or other faculty mentors that are connected with the SaS program. (See section 4.2.H. for details on how the program addresses these problems through the weekly professional development seminars.) In the SaS program, the director plays a critical role in guiding and encouraging students through individual mentoring relationships that are developed during the summer. In the case of graduate students, a number of these mentoring relationships continue throughout the academic year. The program director's belief in the students' abilities is essential for their development of confidence either in their pursuit of a career in the sciences or in their persistence in graduate school. Numerous interviewees, like the one quoted below, described how Tapia's faith in them gave them faith in themselves and enabled them to persist in the face of academic, personal, and financial difficulties:

> Dr. Tapia talked about a lot of people who had gone through such strivings to arrive where they were, and when I was doing work and I would get frustrated and thought there was nothing I could do to figure out what was going

on, he would assure me of my talents. He always thought I was smarter than I thought it was. It's confusing, but he made me believe in myself. And I learned things and I did things that I never thought I could do, just because he believed in me... And that was the most basic thing, just him believing in me and making me feel like he admired what I did. He gives importance to you as a person, as a student. He really believes that you can do it, so that made me feel really good. And then after that he makes you believe that if you can do it, then you can help others do it as well. And that was what really motivated me.

Even minority students who came into graduate school at Rice with very strong backgrounds sometimes found themselves having doubts about their aspirations and their abilities. Time and time again, the program director's faith in their abilities is what pushed them forward:

Professor Tapia has just always been a person that believes that you're going to do it…you're going to graduate, we're going to get you out of here…That makes you think, "Well golly, if he thinks I can do it, maybe I can. Maybe I just need to focus. Maybe I need to look at this from a different angle because Dr. Tapia said I'm finishing"…I think he's played a pivotal role. I don't think I would have [stayed in] without hearing him say all the time, "Oh no, she's going to graduate."…I have this thing where he thinks I'm going to make it, so I don't want to let him down.

Other students spoke of the program director's availability as a mentor—that "his door was always open" and that they could go and talk to him about anything that was on their minds without him ever giving them the impression that they were wasting his time. According to them, the program director's accessibility and confidence in them made his impact as a mentor a powerful one:

R: The SaS program made me more comfortable with myself. And it made me a stronger person, and it made me believe in myself, so, that was a really key point for me.

I: What was it about the program that did that?

R: The director, Dr. Tapia. Because he really cares about us. There's something that, he sends a signal that we can go and talk to him if we have problems. He's always there for us. If we need his help we can always go to his office, he always makes time. So, he was really there to guide me. And he saw the potential that I had at that time that I didn't know about…So then he made me feel that confidence in myself.

The program director's impact as a mentor was especially powerful for those students that needed mentoring the most, the first-generation college students who wouldn't be enrolled in graduate school at all had it not been for the program director's encouragement and advice:

Coming from a background such as mine, you know, people are interested in what made me change. What made me go from zero to 180 degrees, and what has motivated me? And then I think, I've taken a really, really big step, because sometimes I feel like I'm out of my league here. You know, sometimes I feel really insecure. But Dr. Tapia does not give up on me…Which makes me think, "Well, why doesn't he give up on me," you know? "Why doesn't he stop supporting? He must know something I don't." Right? So, I continue to try, and I continue to work. And, you know, one thing that I've learned from him is that you never give up. You know, you just regroup, and these are his words: "You regroup and then you just decide what your next move is going to be."

For many students his role modeling and the mentoring relationship itself were inspirational, driving them to keep aspiring to do their best, despite the difficulties they may face. This is exemplified in the following student's discussion of his relationship with the program director and its affect on him.

Well, as a scientist I really respect him. Every time we go to these conferences, people don't see him as a minority, they see him as a scientist. And then, I'm fortunate enough to see his other side too. I see like, the role as a father, or I see the mentor to me. So first of all I respect him because he's one of the top researchers in America. And I

guess I know he's always gonna be there for us…[He's] pushed me to work hard, and I want to be proud of my research. And also when I go to conferences and give talks, I also want to be proud when I do that, the talk, and I want to do the best I can. Every time I see his face he tells me, "You could do more, you could do more here."

D. The program director serves as a guide to the academic world by providing professional development information and opportunities to participants

The program director plays an active role in the area of professional development, both in his individual mentoring relationships and in the SaS community. The program director serves as a "guide" to the world of academia: he informs students about specific opportunities in their research area, provides critical networking connections for students both locally and at conferences that he attends with them during the summer program, and plans seminars and activities that will assist students in developing the professional development skills. The program director organizes and facilitates the weekly professional development SaS seminars, which will be described in more detail in section 4.2.H. A number of the students we interviewed discussed the program director's role in providing networking connections and overall advice and guidance in the area of professional development. The following are examples some of the student comments.

> Dr. Tapia makes sure you do know everybody…If he has a party at his house, he makes sure the newer graduate students meet all the professors. "Do you know so and so," and he'll start a conversation and leave. Or like, when you go to national meetings he'll introduce you to these world famous mathematicians. He says, "This is Joe," and you go "Joe?" and he goes "Joseph so and so," and you're like "Oh my God! Oh my God!"
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> ****
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> [His advice] is just real helpful. He gives so much advice he's like a father in the department. He gives you advice on what classes you should take, what conference you should go to, if you should give a talk there, and how to how to get letters of recommendation. He just gives a lot of advice.

E. The program director maintains a position of influence and "clout" within the university, enabling him to actively support the students' academic and financial interests

Another essential element that emerged from our interview analyses was that the program director of SaS has influence and leadership within his department and in the university because of his academic accomplishments and his connections to the CRPC. This situation benefits the SaS program because it puts the director in an ideal position for garnering funding and support for the program and its students. A number of interviewees felt that for a program like this one to succeed, it must be integrated into relevant departments and research centers as much as possible so that the program is not seen as a marginalized "minority program" but as an essential element of the department or center's outreach efforts. To ensure this centrality, the program director should be a highly-respected faculty member or researcher who has at least some degree of power and influence with respect to financial resource allocation. As one student articulated it:

> If the person who's in charge of the program has no power whatsoever, no power over funding, this is just another minority program. And, like, who cares? You come in, you do this, you do that—but that's it. Tapia had a certain level in the university—plus he had the purse strings. This sort of gave credibility to the program. So it really was important…It's not like [the university is saying], "This is what we do. This is our token minority program. This is what we do for minorities and here's your little amount of money…Stay over there." I've been in some [programs] like that…I don't feel this is like that…The other kind of [minority] programs have a low-to -mid-level person, possibly with a nice title, but they're still not given any respect in the job that they do. You know, you might be an assistant dean of this or that, but you get no respect by the higher echelons at the university…And the faculty all think you're a joke, and they say things like, "Okay. Whatever. Are they one of those minority kids that we have here right now?"

A number of interviewees provided examples of how the program director had used this influence and "power of the purse strings" to provide funding for them when other sources were not available or to stand behind them when other faculty members questioned their potential or right to be at the university.

F. The program director creates and actively sustains a strong SaS community

In our interviews with the program director, he expressed the critical role that the SaS community plays in the successful recruitment and retention of minority students. The community provides an important complement to the individual mentoring relationships that the program director and other SaS faculty mentors maintain with many of the students. It builds upon and diffuses the mentoring and support to a broader base of individuals (this will be discussed in detail in section 4.2.D). In our discussions with students it became clear that the program director was instrumental in creating and sustaining the SaS community and that this was an essential element of the role of the program director.

Such a community will not form spontaneously. The program director must play an active role in creating the overall culture of the SaS community. One of the ways in which he accomplishes this is through modeling the community connections that he thinks are important through his inclusiveness and way of relating to the students. One student described the way that the program director relates to the group:

> Yeah, you see, he thinks of us like an extended family. He always says that. Which is very true, because during the summer he has parties at home and even during the school year…and he attracts minority students from other departments. He's got parties at his place, and you know, we all just mingle and hang out, socialize…And this is very natural. You just go over and his wife, and his son and his daughter, and all these things. And he shares his personal experiences with us, things like that kind of just brings you more into the family. He wants to try and understand and kind of bring in this connection…

The program director is also explicit about his expectations for the community and the people who participate in it. A student described his approach in the following way:

> He says, "This is going to be the culture of the group." And he's able to come right out and say, "This is what I want. I want us all to cooperate. I want us all to work together." You know, "I'm going to have--" and he has no qualms about saying "We're going to get in a group. It's going to be a Black and a Brown, a boy and girl." He'll say those exact same words.

The program director also actively facilitates and enhances community formation through engaging the students in tasks and activities that require collaboration. One component of this is that the program director involves the students in the running of the program. Through encouraging this kind of student input he gives the group ownership of the program. This, along with the leadership opportunities and the cooperation this entails, are essential to the building of a strong student community. In order to allow students to play this role, the director cannot maintain a rigid program structure. The program should be flexible enough to adapt to the changing needs of the students who participate in it over time.

4.2. Essential elements of the SaS student community

The role of the SaS student community in the success of the program cannot be underestimated. While the program director plays the role of mentor and guide for many of the students in the program, the size and cohesiveness of the SaS student community allows support to come from multiple individuals rather than a single mentoring relationship. As a result, students within the community can "fill in" for the program director in circumstances where he is not available and can gain their own valuable experiences as mentors. As seen in Table 4, the presence of, and interactions with, other minority students in the program greatly increased the desire to attend or remain in graduate school for 41% of those surveyed and somewhat increased the desire of another 48%. This is consistent with research on graduate school success and retention, which has found that interactions with peers (as well as interactions with faculty) were a more important determinant of success in graduate school than were undergraduate background and personal characteristics (Blackwell, 1987; Girves and Wemmerus, 1986; Hartnett, 1976; Nettles, 1990). Minority students often feel outside the mainstream of their departments and often have problems interacting with faculty members (Carrington & Sedlacek, 1976; Allen et al, 1984; Clewell, 1987; Nettles, 1990; Smith & Davidson, 1992; and Turner & Thompson, 1993). Therefore, for minority students in particular, interactions with graduate student peers may provide an otherwise difficult-to-obtain connection to their department and to other researchers. Within the CAAM department at Rice University, the SaS student community provides a vibrant and ongoing forum for such interactions to occur.

Our analyses of survey and interview data determined that there are eight interrelated characteristics of the SaS student community that are essential to the demonstrated success of the SaS program. This multi-ethnic student community aids in minority student recruitment and retention because it:

A) surrounds participants with students from similar backgrounds who understand their experiences firsthand
B) provides undergraduate participants with numerous graduate student role models
C) provides a matrix of mentoring relationships between students at different levels so that each student can both be a mentor and be mentored
D) allows support and advice to come from many individuals rather than having students rely on a single mentoring relationship
E) has continuity and is sustained through having students participate for multiple years
F) is fully integrated into the life of the department and receives legitimacy through its connections to a respected research center
G) provides an open forum for discussions about race and ethnicity
H) provides instruction, practice and encouragement in professional development

Because essential elements A through E all refer to the matrix of interconnections between students in the SaS program and there is a high degree of overlap between them, we will cluster these elements together for the purposes of discussion. The community's remaining essential elements will be discussed separately.

A-E. Essential elements having to do with the nature of the community matrix

Because there is a "critical mass" of minority students in the SaS program and because this community of students includes both undergraduate *and* graduate students, the SaS student community is unique among summer research programs for minorities. As seen in Table 6, the vast

majority of SaS survey respondents agreed that the mix of graduate and undergraduate students was critical or very important to the overall success of the SaS program. This mix of students at different levels creates a large and permanent community matrix which: (a) surrounds participants with students from similar backgrounds who understand their experiences firsthand, (b) provides undergraduate participants with numerous graduate student role models, (c) provides a matrix of mentoring relationships between students at different levels so that each student can both be a mentor and be mentored, (d) allows support and advice to come from many individuals rather than having students rely on a single mentoring relationship, and (e) has continuity and is sustained through having students participate for multiple years.

Table 6: How important do you think it is that the program include both graduate and undergraduate students?

Degree of importance	Total	%
Critically important	18	67%
Very important, but not critical	5	19%
Somewhat important	4	15%
Of little or no importance	0	0%
Total	27	100%

Within the SaS program, participants are immersed in a community of people from similar backgrounds who understand their experiences as minority students firsthand, giving many participants their first experience of not feeling alienated and alone within an academic setting. As seen in Table 4, 89% of the SaS participants surveyed said that simply being in the company of other minority students during the SaS program increased their desire to enroll or remain in graduate school. Interviews with SaS participants corroborated the importance of this "critical mass" of minority peers in retaining program participants in graduate school. As one student described it, being in regular contact with and discussing your experiences with other students like yourself is "important because you get to understand them and know that it's not only you that has been through this—that they're also going through a similar experience…I feel I can relate to them because their background is the same as mine." In a prior LEAD evaluation of minority students' experiences on a predominantly white campus, it was found that interacting with other minority students not only allows students to find support and share their experiences with people who can truly empathize, but it gives minorities a chance for a "reality check"—a chance to see whether their feelings of isolation and estrangement are theirs alone or whether it is a phenomenon related to race (Alexander, et al, 1998). Some SaS students recounted how they had felt extremely isolated as a minority student on the Rice campus and how seeing others like themselves reassured them that it was possible for them to continue on their path towards an advanced degree. By taking students from several departments and including both undergraduate and graduate students, the SaS program provides a critical mass of minority students and allows them to form connections with other students they may not have otherwise met. This allows participants to feel like they are integrated into the life of the university rather than feeling alienated and isolated. As one participant who participated in a corporate internship instead of the SaS program during her first summer as a graduate student explained:

> R: Those first two years [of graduate school] were like hell to me because I didn't know anyone. As a minority you feel so isolated because all of [the students in my department] were either white or oriental or from India. I was the only Mexican American female, so it was so tough on me because I couldn't get into any of those groups. But when I came here and I saw all the other people like me, and I also saw all the other women in the department of CAAM, it made me feel much better and see that there was a possibility that I could continue my education. So it

was like coming from hell to heaven for me…Before I felt really isolated.

I: Did it make you not want to continue? It sounds like you got a Masters, and now you're in the Ph.D. program.

R: Yes. I even switched programs…because of SaS…I think the change was that I saw a lot of women in the Ph.D. department here in CAAM, and that encouraged me to continue my education. I saw role models that I could follow, so that was a key point in my career…Before it was hell… because I had no one to associate with. There were no minorities in my department.

Even for some undergraduates, their experiences in the SaS program motivated them to go back and form student communities in their own undergraduate departments. These activities made them feel "a part of" their universities for the first time:

I: So you expected to have the program help you fit in at Rice, and you said that it actually did in a lot of ways—you met a lot of people. How did that come about?

R: Well, in the program we had meetings on Fridays and I met a lot of the students there, and then just with talking Dr. Tapia really motivated me to go out and do something to help others, just like I thought he was. I mean, he really helped me a lot. So during the summer I had two meetings with the people who were the head of my department's minority student club and…I just started plans to gather up these people and start doing something good to motivate these people, especially in science and engineering, which was my interest. And once I got back into the regular school year at Rice …I started meeting a lot more people and formed a study group from the people I was meeting there, and then also helped the minority students that were coming in as freshmen to adapt. I felt like I was finally part of Rice because I was interacting with the other students and I was doing something there that was part of the whole Rice campus.

For almost all of the students we interviewed, the SaS group was perceived as a closely bound, supportive community that they could rely on no matter what. It was the group to whom they turned to receive emotional support, encouragement, and advice as they faced the difficult challenges of being a minority and being a graduate student at Rice. Numerous students described it as a "family" or a "home away from home." When graduate students were asked about the SaS community during a focus group, they described it in the following way:

R1: I think you could say we see ourselves as a family. We care a lot for each other, you know. If someone is taking an exam, we're asking them questions, and saying you should do this, and go and talk to the professor. When someone's having a problem, we always try to find out how to help that person. So, you know, that's how family works…We're there for each other.

R2:…And it doesn't end in August…We're there for each other throughout the year.

I: Ok. Let me ask you this: Did that happen in the SaS program, or was it before the SaS program?

R2: It happened in the SaS program, where a younger graduate student is comfortable going to an older graduate student and asking them questions, asking them questions about science and life in general. As opposed to where you may feel hesitant to knock on the door and talk to this individual.

I: So it creates a place where you feel comfortable going to somebody, where otherwise you might not feel that?

R1: It breaks the ice. So that by the time you get to your first year, or the summer before your first year, or if you have just finished your first year and you are worried about your preliminary exams, you already have someone to go to. I mean, you've gotten to know a person basically through interactions through the program. You know, they've seen you for three months, they're not gonna go "Who are you?" when you knock on the door…And all the

graduate students are busy so you may think you may not want to go ask them something, but in this group, everybody is asking everybody. So you don't feel as bad about asking…You don't have to be shy about it. And you know you'll do it for other people in return…So you don't feel so bad about asking other people because you know it's like this cycle where everyone is helping everyone.

Like a family, the SaS community doesn't simply disappear when its youngest members leave for the regular school year. As the discussion above illustrates, the fact that the community incorporates graduate students who are present throughout the year makes it possible for the SaS social infrastructure to remain in place even after the summer has ended. In other words, the program has become a launching pad for an ongoing, CAAM-based community that sustains and supports its graduate student members year-round.

The community is further perpetuated by having undergraduates and graduates alike participate for multiple years**.** This allows a continuity and sense of permanence that few other summer programs have. The SaS students we surveyed agreed that having students participate for multiple years was an important aspect of the SaS program. As seen in Table 7, 56% of those surveyed thought this aspect was "critically important," while another 37% rated it as "very important."

Table 7: How important do you think it is that the program include students who have been in it a number of years?

Degree of importance	Total	%
Critically important	15	56%
Very important, but not critical	10	37%
Somewhat important	2	7%
Of little or no importance	0	0%
Total	27	100%

SaS "repeaters" are the bearers of the community's shared history and culture; it need not be created anew every summer. When graduate students in a focus group were asked why they thought it was important that students participated in the SaS program for multiple years, one replied:

For continuity it's important. One, because you're not hashing out the same thing over-and-over. And two, because people aren't as committed to a community that they know they're just going to leave at the end of the summer…I felt like what I could give back progressed each summer. SaS became more important to me substantively as I progressed, because it allowed me to present my research, and it made me feel validated in the work that I would do. I could see where I had grown, and where my friends had grown. We were able to come back and say, "God, remember the first year? It sucked." And we were able to say, "Here we are four years later, and we're polished." And that was a huge part of being able to judge yourself, not based on what your department says…but being able to judge on a personal level where growth has occurred. That was really important for me…the fact that Tapia would allow me to come back year-after-year and say, "You have something valuable to add to this."

Another important aspect of this "family" is that it consists of peers who understand first-hand the difficulties of being a minority in graduate school and the challenges of attaining an advanced degree. A number of the students we interviewed were first-generation college students and did not feel that their families could understand important aspects of their current lives. These students in particular needed support from others who not only understood, but were experiencing the same reality. As students in the graduate student focus group explained:

R1: I think it's important anywhere you are to know you have allies. To know I can go to this person's office and

gripe and gripe and gripe and he won't go, "You know what? She was in my office, and she's just a complainer." People who know you well enough to go "Oh, she's just having a bad day, she doesn't really mean she's going to quit." Or on the other side of it, someone who just get tears in their eyes when you passed your exams and says, "YAY!"

R2: Most people don't have family in Houston.

R3: And even if you do, they are not always nearby. And they don't know what you're going through as well as the people-

R1: -who are there [in school] too and can understand what you're doing.

R4: They don't understand what you're doing, they haven't been there. People that are going through the same thing really help.

R1: Because when I came to Houston, I didn't know anyone. You know? I've made lots of friends through SaS…And even if some people do have their family here, they still need to have a peer family… I don't think a great number of people understand what a graduate degree is. You know, there's a chain of grocery stores in Houston called Rice. Part of my family thinks I work at a grocery store! Another part still thinks I'm an undergraduate. I mean, I don't even argue with them anymore. Others think I work at Rice as part of the staff. So I've stopped trying to explain.

Because both graduate and undergraduate students participate in the SaS program and because participants are involved in the mentoring of minority high school students, the SaS community creates a chain of mentoring relationships between students at different levels so that each student can both be a mentor and be mentored. Hence, not only are role models and guides provided by the students and professors that are "ahead" of a student, but each student becomes a role model and guide to those "behind." Many interviewees said this situation allowed them to feel like they were giving back to their ethnic communities, a "duty" that the program director himself repeatedly emphasizes. Past research has suggested that high-achieving minority students often feel the need to give back to their community in order to demonstrate that they have not abandoned it (Seymour & Hewitt, 1997). The SaS program gives multiple opportunities for such reciprocation to occur, regardless of the student's level or length of time in the program. Participants in the SaS program expressed the belief that such relationships encourage both the mentor and the mentee to persist in pursuing their degrees. As one student remarked, "There are people here that count on me and who would be disappointed if I didn't finish." Another said:

We share our experiences with [the students we mentor], but I also think that we mentors, we gain a lot…Because it makes us realize that we have achieved so much. You know, and that gives you a lot of confidence in yourself, so I think it works both ways. When I talk to them about my experiences it's like "Wow, I've done a lot." And then they say "Wow! You've already got a degree and you're working towards a PhD." It makes you feel good and want to keep it up.

The undergraduates we interviewed felt that they benefited from the advice and the mere presence of so many graduate student role models. As one undergraduate said:

To get undergraduates into this field or to keep them and have them go on to graduate school, I think it's really important to allow them access to graduate students. To have them work closely with graduate students, to get a good feel of what that life is like so that when they decide or if they decide to go to graduate school, they're making an informed decision.

Meanwhile, the graduate students we interviewed tended to emphasize how much they enjoyed helping a fellow student in the way that they themselves had been helped—or wish they had been helped—earlier in their careers:

> R: With mentoring students…I always stress my background: where I come from and how I got here. And I try and stress that they should also be helping other students, because there's always like a domino effect. You know, you help someone, and then that person should be helping someone, and so forth. I think that's how you can get more of the critical mass.
>
> I: How important is it for you to be mentoring? To be doing that, playing a role in that domino.
>
> R:…It's very important because I think this keeps me focused with life [outside of Rice]. As a graduate student…you get too focused on your job, you…study from 9 to 12…and you forget about the real world…And when I mentored, that kind of kept me in touch with students. How their family is at home…some that have been doing drugs. And I've thought, "Oh Jeez, try and do this, or call so and so," and it just keeps me in touch with that. And it lets me know that school is not the only thing in life. It's an aspect of it, but you should also be learning about other things.

Finally, the size and cohesiveness of the SaS student community allows support to come from multiple individuals rather than a single mentoring relationship. The burden of mentoring is thus shared, leaving no mentor overwhelmed with requests for help and no student-in-need without timely assistance. Because of the community matrix in the SaS program, there are always numerous individuals to whom a student who needs help or advice can turn.

F. The community is fully integrated into the life of the department and receives legitimacy through its connections to a respected research center

A number of the administrators and program participants we interviewed feel it is essential to the success of a minority retention program like SaS that it be integrated into relevant departments and research centers as much as possible. By "integrated" they mean that the program should not be seen as a marginalized "minority program" but as an essential element of the department or center's outreach efforts. In our interviews, the program director and several graduate students emphasized the program's connection with the CRPC, a connection that they feel legitimizes the program and lends credibility to the work done by its members. Because it is part of the CRPC, the SaS program receives much more respect and support than other minority programs on campus. Its student community both receives support from and works to support the mission of the department and the research center with which it is associated. One graduate student described the situation in the following way:

> R: Tapia does a huge job to integrate the program into CRPC and into CAAM. Like, he has people come in to speak to us, and he has gatherings at his home where he invites the people to come…and we get to know them. You become a member of the CRPC community here. It's just the little things: They link your personal home page to their home page. They pull you in. It's not like a little blurb, "Oh, we have this program." Tapia and the CRPC are literally proud of us, or at least they put on a great show of it. The other kind of programs…you get no respect by the higher echelons at the university…and the faculty all think you're a joke.
>
> I: And what's the difference for you as a participant? What does that make you feel to be in the two different kinds of programs?

R: To be in the second kind, it basically only aggravates the feelings that you already have that you might not belong there. To be in the second kind of program continues to make you feel like an outsider. The first kind is Tapia's program--it really makes you feel like an integral, important part of CRPC. And he would say in the meetings, "You all are an important part of what we do. We do outreach. You all are a big, huge, important part of that." And you also really contribute [to the CRPC] by mentoring and by submitting research papers…And we have a place. It's not like on the outskirts, you know, and all dingy. We have a nice place that we meet every Friday, and it's our space. And it's not a space that's on the margin or in some minority room or whatever. It's CRPC, just like normal people.

The SaS program is integrated into the CRPC financially as well as structurally. Participants' summer financial support comes with the requirement that they participate actively in the SaS community and relevant CRPC events. This arrangement promotes integration into the department and life of the university in a way that fellowships with no departmental duties do not. Research has shown that forms of graduate financial aid that require close and early interaction with faculty members and other students—like teaching and research assistantships—promote stronger departmental ties and less isolation than the fellowships and grants that most minority graduate students receive (Nettles, 1990). Girves and Wemmerus (1986) found that these departmental ties are directly related to doctoral progress. As a result, researchers like Debord and Millner (1993) have recommended that graduate retention programs link financial support to research participation with faculty and to participation in a community of student peers. Rice's Spend a Summer with a Scientist is such a program.

G. The multi-ethnic SaS community provides an open forum for discussions about race and ethnicity

The multi-ethnic group of students that make up the SaS student community may see themselves as "family," but like every family, there is diversity and conflict within it. The reader should not mistake the SaS program's emphasis on community and cooperation as an indication that relationships within that community are not without tension. The students who participate in the program come from a variety of ethnicities and cultures that in many real world circumstances do not get along. These racial and cultural tensions are confronted directly as a strategy for teaching students how to work out one's differences in a constructive manner. Through the group's weekly discussions about race and ethnicity, students are taught that difference of opinion and cultural conflict are inevitable and that this needn't be a problem if conflicts are handled with tact and respect for the other's point-of-view. In effect, the SaS program's discussions about race are a method of "inoculating" students: Through forcing students into openly confronting their racial and ethnic identity and the fact of living in a society where this identity is problematized, the program prepares students for negotiating racial tensions in the real world. Students in the program discuss what it is like to be the target of prejudice, and because they do so in a multi-ethnic group with students who have different racial backgrounds and opinions, they must often confront their own prejudices as well. The program director elicits and encourages such frank and emotionally-charged discussions as a way of getting students to acknowledge and accept intergroup diversity and to recognize that, just as in a family, diversity and differences of opinion needn't drive them apart. A number of students thought these discussions were important to the cohesiveness of the community and to their development as professionals, as seen in this excerpt from a focus group:

R1: You learn how to discuss issues without fighting. You know, when we talk here we can discuss different issues without saying, you know, because you're an African American, because you're a Mexican American, it's different you know. And we can talk about anything, that's something I really like about the group's meetings

sometimes.

R2: Discussing racial identity isn't exactly something that's a part of the graduate student curriculum during the year. I don't think it ever comes up. It's nice to have a release, to release all that energy for every Friday for 3 months.

R3: It has helped me interacting with people who aren't just like me…And you never really learn to understand each other unless you interact, and you talk about problems that each side faces. So you may have your mind set on "Well why do they think this way?" but until you really interact and talk, only then do you really get to understand each other better. You learn how to work with people of all different races, nationalities, genders, in a professional environment.

The program director has other strategies to keep the group from fracturing along racial lines. He sees the SaS community as a microcosm of the world outside—a world where "Black" and "Brown" must learn to get along. To promote interracial cooperation and understanding, he makes a point of grouping students in ways that force racial integration and actively tries to prevent ethnic cliques from forming. One student described the impact of this strategy on the community:

Very easily in other programs, you could see the Black kids sitting together and the Hispanic kids sitting together. Tapia always made it an effort to be like, "Okay, we're going to match up a Brown and a Black and a boy and a girl." Whenever we went on trips or whenever we assigned mentors, we mixed it up…By my fourth year I was helping run things, and I was assigning people to mentors, and we knew Tapia's mentality: It's got to be a man and a woman and a Black and a Brown. He sets the tone of cooperation and commitment. You know, "You're going to help each other through this." And honestly, I think Spend a Summer works because of that.

That these discussions were an important part of participants' SaS experience is further reflected by the fact that, as seen in Table 4, 74% of those surveyed said that the group's discussions about race and ethnicity increased their interest in enrolling or remaining in graduate school.

H. The community provides instruction, practice and encouragement in professional development

Research on graduate education has found that research knowledge and skills are not sufficient in making a successful academic (Bland & Schmitz, 1986), professional socialization is also critical for success (Turner & Thompson, 1993). Unfortunately, access to professional socialization has been found to be especially difficult for minority students (Turner & Thompson, 1993). The SaS program directly addresses this problem by providing participants with instruction, practice and encouragement in professional development that they otherwise might not receive. Interviewees expressed that these meetings were essential in teaching them how to have discussions of debatable issues in a constructive way, how to tactfully disagree with academic colleagues, how to explain and give presentations about their work, and how to conduct themselves as professionals in an academic setting. When surveyed about the impact of the professional development discussions, 69% of respondents rated them as having a high or very high impact on their feelings of preparedness for a career, and 54% said they had a high or very high impact on their feelings of preparedness for graduate school. In the end, the discussions about professional development increased interest in enrolling or remaining in graduate school for 79% of the SaS participants surveyed (see Table 4).

One student described the impact of these Friday discussions in the following way:

In…having the professional development meetings, you're…learning how to give talks, and what's appropriate dress, and how do you speak to the teachers, how do you present a paper, how do you publish a paper and how do you approach someone to ask them to be your advisor. So it's a lot more intense [than what you get during the year]. The social thing is the same all during the year, but it's the big graduate student sort of topics that you get from SaS—surviving graduate school, and dealing with being the only minority if this has never happened to you before in a class, or you're dealing with having to ask questions of a professor, a non-minority professor if you've never had to do that before, and all those sorts of things.

As seen in the description above, the SaS program appears to provide some of the professional socialization that would traditionally come from a mentor or advisor, thereby filling the gap for students who do not feel they receive enough of this information from faculty members. It also provides a relatively risk-free environment for minority students to receive explicit guidance and practice in their professional skills. This method of professional development may even be more effective and efficient than learning such skills from an advisor because students are able to learn from each other's successes and mistakes and because it meets the needs of a whole group of students simultaneously.

However, there are many things important to a student's academic and professional advancement that only an advisor can provide. Literature on graduate education suggests that the advisor is the primary socializing agent in the department, and those graduate students who succeed tend to be those whose advisors introduce them to colleagues, take them to elite conferences, and co-author papers with them (Girves & Wemmerus, 1988). As noted earlier (in section 4.1.C), research suggests that minority students often face challenges in establishing relationships with faculty members. Hence, in addition to providing professional development training, the SaS program encourages and assists students in forming linkages with faculty. During the Friday forums, SaS participants are instructed in how to approach faculty members and form professional relationships with them so that they can receive the essential socialization that only advisors or other faculty members must provide. A number of interviewees, particularly those who had come from HBCU's, discussed how it was initially very difficult for them to feel comfortable approaching white faculty members at Rice. For these students, the SaS program's discussions about how to approach and make the best impression on faculty facilitated the students in overcoming their fears. As one student explained:

The SAS program taught me to be professional in my research, and the way I should conduct myself in the work environment. So I give a lot of credit to the SAS program…We'd have weekly meetings and discuss things like…how to approach a person if you think something is wrong and you don't want to holler at them, you just want to come to them in a professional manner…The first year it mainly gave me a little bit more confidence in talking to faculty and it really taught me how to approach them and start a conversation.

4.3. Essential elements of the research project

Since participants in the SaS program spend the majority of their time working on their summer research project, the project is for most the focal point of the program. For the undergraduate interviewees in particular, the research component of the program was key to the program's impact on them and their decisions regarding graduate school. As one commented, "The most important part for me would be the research…I mean, that's what takes up most of my time. The [Friday] meetings are 2-3 hours every week, and the high school mentoring and presentations are a couple weeks, so those are important too, but the research is what I think is really important. That's what we're here for." Furthermore, as seen in Table 4, the experience of doing research in a university setting played

an important role in encouraging nearly three-quarters of the SaS survey respondents to want to enroll or remain in graduate school.

Our interview and survey analyses determined that there are five characteristics of the summer research project that significantly contribute to the demonstrated success of the SaS program in graduate student recruitment and retention. In brief, the research project is integral to the Summer with a Scientist Program because it:

A) allows students to experience and learn about the research process through working on an unsolved, open-ended, real-world research problem
B) increases participants' disciplinary knowledge and their understanding of how that knowledge may be applied
C) assists students in defining and refining their research and career interests
D) provides students with an introduction to the world of academia and graduate school
E) provides a forum for collegial interaction with a faculty member

A. The research project allows students to experience and learn about the research process through working on an unsolved, open-ended, real-world research problem

For many of the SaS participants, particularly the undergraduates and first-year graduate students, working on the summer research project gave them their first experience with research. These students had to learn how to deal with the open-ended nature of the research process and how to design an original research project that would produce results in just a few months' time. This experience was challenging for most of them, frustrating for a few, and a valuable learning experience for almost all. When asked why the research component was so important, and so challenging, one student responded:

> Because you have to learn so much about a topic that you either haven't thought about or weren't even interested in, but you sort of research it to see how it applies to, in my case, mathematics and computer science. All that research and digging was the hardest part because I didn't know exactly how to research, how to go about it, how to discover something worthwhile in just a 3-month span, then being able to know enough to do a project and to present it.

Through working on a hands-on project throughout the summer, the SaS students not only learned about a particular subject in depth but also learned the step-by-step process of doing research. As one undergraduate said:

> I think the most important thing for me about SaS is the exposure to research topics, and understanding what are the steps involved to research…I'm learning how to do research. At my undergraduate school, I did some class projects that were like research, but here my advisor's actually doing this project as part of his work, so it's real, and I'm learning the steps required to actually do research. Like how to define a problem, and once you've defined that problem, what steps do you take to be able to solve that problem.

The fact that the research on which they work is "real" was of major importance in motivating and holding the interest of many of the undergraduates who worked on summer projects. It also motivated several to be more interested in their coursework, because they could finally understand first-hand where all the rules of procedure were coming from and why they were necessary. As one explained:

> What I mean by real research in math is having a problem that somebody has submitted papers on, so you have to go and read these technical papers, and try and figure out what these other people have written, so there's a lot of research trying to figure out the problem. Having a problem that takes like a month to really understand and figure out, and then you start adding what you want to do…That's what I mean by real: a high level of complexity, and it's current, and it's done by a collaboration of people. Like right out of those math journals that you always see… I mean, we had been doing little toy things at school, but when you see something that's been worked on for several years by many grad students, you come to realize, "This is why we have standards. This is why we do things a certain way." It no longer seems to be an arbitrary, pedagogical point like: "You will name your variables this way." It's like, "Oh. Okay. That makes sense."

For students with little prior research experience, to be able to work on "new" problems is essential in giving them the self-confidence to see themselves not just as students, but as researchers. When their mentor trusted and valued the work they did, SaS participants realized that they had the ability and the knowledge to contribute to a problem that was being worked on by an eminent researcher. This was important in convincing many students that they had "what it takes" to succeed in a research career. As one student whom we interviewed near the end of her graduate career explained:

> I think what I liked mostly that first year was working on something that no one else had ever worked on. It made me sort of feel like a grownup. You know, I had the world-renowned researcher saying, "Well, how did the code go? What did you find out? Show me your results," and actually being interested in what I came up with. Telling me, "There's some new software out. We don't know how to work it. We want you to learn how to run it and explain it to us." I'm like "Wait, I don't even have a bachelor's and I'm explaining stuff to you?" When I did it, it made me feel like I had accomplished something: that I could be a peer of these people; that I had something to bring to the table.

Another participant who had been in the program multiple years recalled how important getting an introduction to the research process had been during his first year with SaS. Like many of the participants who eventually went on to graduate school, he found that he really enjoyed the intellectual freedom and flexibility of working on his own research project.

> During that first summer, I was working on code, and I was actually producing the code, you know? And it was really cool, because I had never done anything like that before. So that was my first actual involvement with research. And I liked it. It's not at all like a job, you know? When you work somewhere, you have to be there at a certain time and then you leave at a certain time, right? During that summer, I could work anywhere at any time I felt like it. If I felt like working at midnight and I had an idea—which happens a lot—I can just start working then. I don't have to be anywhere at a specific time. You have a lot of freedom, you know? But I realized that could be bad because you could hang yourself, you know, with so much time on your hands.

Another student concurred that the "freedom" of being a researcher could be dangerous without organization and discipline. Like many in the SaS program, she learned that learning how to be self-disciplined and motivated from within is an important part of becoming a researcher:

> It's hard sometimes being that independent, but it's good. Cause that's what real research is like, you've got to be motivated. And you've got to teach yourself to be motivated, because when you're unsupervised later, when you're doing research and when you become a professor, you have to find your own motivation without someone breathing down your neck.

Participants in the SaS program soon learn that not only are research work schedules less structured and predictable than those in other jobs, but the problems to be investigated are far less structured than anything they have encountered in school. Furthermore, the answers to the questions they ask as

researchers are generally far less clear than what their undergraduate textbooks would lead them to believe. These lessons are critical to understanding the true nature of the research process, and to knowing whether it is something they would ultimately enjoy pursuing as a career. As one interviewee explained:

> Before SaS I didn't understand [research] very well, you know? I thought that you just chose a problem and then you just worked on it and you kind of built up the questions as you worked on the problem, right? But the problem has to be clearly defined at the start in order to be solved. I also realized over time that there are some problems that cannot be solved—incomplete problems and these kind of things.

B. The research project increases participants' disciplinary knowledge and their understanding of how that knowledge may be applied

A number of SaS interviewees, particularly undergraduates and first-year graduate students, expressed that their research projects increased their knowledge of their discipline and gave them a more concrete understanding of how the things they had learned in classes could be applied to real world problems. Many students came into the program with a theoretical math background. They had taken many courses in mathematics, but had not yet had the opportunity to see mathematics applied to real-world problems. Seeing and understanding how math can be applied to many different areas like biology, medicine, and mechanics helped these students to look at mathematics in a different way. No longer a just logical exercise, mathematics became a powerful tool. As one student explained:

> [Compared to my undergraduate courses], what I was doing in the SaS program was something totally different…But the project sort of put everything together and was hands-on work with my background, with what I had learned so far. And it was pretty neat. It was more along the lines of economics than anything else, so it sort of gave me an example, "Hey this is how I can use what I know."

Another said:

> One of the things that I did like about [my research project] is you always hear about applied math, and now I actually see what it is. I did like that. The problem I'm working on is a mathematical model of a cross-section of an optic fiber, so it really is applied. You always hear that it is applied, but then when you are actually seeing it, it's like, "Whoa, it's *applied*!" You're seeing it first hand, so it makes a difference.

For students who thought careers in mathematics meant careers as teachers or theoreticians, working on an applied math project in the SaS program was a happy revelation that reinvigorated their interest in their discipline. As one student said, "I just never thought you could do those things with math. It was really nice. Kind of complicated, but nice." For several students, this revelation had real consequences on their career choices, as seen in the examples below:

> What I enjoyed about [my research in the SaS Program], was just basically doing something in my area, doing something that could be applied to the real world…I really didn't have any summer research ever in undergrad, and I was just happy that math could *do* some things…It really influenced what I wanted to study in math…Because I really wanted to do something with what I learned, and applied math was more of a way to do that than pure math.
>
> **********
>
> [The SaS program] is where I found out what the grad students at Rice were doing, and all of it was applied mathematics, and I just thought that was great. 'Cause all this time I was just learning theory, and I thought, "How

> can I apply this to work in industry?" And so that's where Dr. Tapia came in, and then that opened up a different path, and that's when I decided I'd make the switch. Make the switch from pure to applied.

The renewed enthusiasm expressed by these students when they found out how mathematics could be applied to real-world problems is consistent with research by Seymour and Hewitt (1997) who found that minority and female students often eschew science or research careers that do not have clear applications to problems in the real-world.

C. The research project assists students in defining and refining their research and career interests

Once SaS participants had a greater understanding of their discipline, they were better able to make choices about their careers and what, if anything, they wanted to study in more depth. In many cases working on summer research projects assisted students in defining and refining their research and career interests. This point was already touched upon above, in that some students were convinced by their SaS research activities to make the switch from pure or theoretical mathematics to applied mathematics. But even for students already in applied mathematics and the computational sciences, the research projects they worked on during the summer helped them to select subdisciplines or specialized areas of study for their graduate research. In a number of cases, projects began during a summer in the SaS program developed into a graduate student's dissertation research. One graduate student said that participation in the program, which was mandatory for minorities in the CAAM department was widely seen as "a way to sort of get ideas for our thesis and have practice working on real research so that when we work on our thesis and stuff we already have a bit of experience." As such, the SaS program gives its graduate participants a head-start that graduates not involved in research during their first few years will lack. Another student described how the program guided her in choosing a subdiscipline and her graduate courses:

> My summer experiences helped guide me throughout my graduate career. My first time, I worked with a professor who worked on non-linear optimization and I kind of liked that, and then I went to AT&T and that got me interested in network operations and being in communications. Then the TSP I worked on in SaS the next year got me going at TSP. All of them were great experiences, and I would kind of like to like to stay in both areas, but you have to decide on one, so I decided on operation research. But I still go to some courses on optimization just to be versatile.

D. The research project provides students with an introduction to the world of academia and graduate school

Through participating in a research project, many participants also came to understand what life as a researcher was all about—what their professors do outside of class and what it is like to be a graduate student. This new information and understanding made it easier for them to make choices about enrolling in graduate school themselves. They were able to work and personally interact with people in every stage of their academic research careers—from undergraduates on their first research project, to new graduate students, to graduates studying for qualifiers, to dissertators, to post-doctoral students, to professors. Participants had only to observe and ask questions of those around them to get an accurate picture of the life of an academician and researcher and to get a clear view of the path that lie ahead if they chose to enroll in graduate school. One undergraduate participant described her experience the following way:

> I got started on a research project [during SaS], and that was really important…It really gave me a good idea of what kinds of things I could do as a graduate student, of what it's like working with a professor…The research is important because that's what you have to do in grad school. And if I felt like I couldn't find something that I wanted to work on, then why come to grad school for the next five to six years?…In graduate school you have to motivate yourself to work on the problem because you get no grade. You set meetings with your professor, and it's a lot more informal…And knowing all that ahead of time is important, especially since that's what the next 5 or 6 years of my life would be like…And after spending the summer and getting to know Dr. X and Dr. Tapia and other grad students, it seemed like something I could do…The SaS program really helped me to think about those things.

For those students considering graduate school at Rice, the experience was especially informative. One interviewee who had participated in the program as an undergraduate and then as a graduate student described the impact of the SaS research project on encouraging her to enroll in graduate school at Rice:

> My decision to come to graduate school was made during that [first SaS] summer. The summer before I had been in another program that was sponsored by UC-Berkeley, but they didn't convince me. Now I don't know <u>what</u> here changed my mind, but somehow coming to this program changed my mind. Working with a professor on something, and seeing the applications that were interesting to me, and actually having to be a fake graduate student for three months, I guess, is what convinced me and made me want to come to graduate school. I was in the same office as all the first-year chem graduate students, so I interacted with them. But I can't say that the interaction with the students is what made me change my mind, because in the program the summer before I did that too and that still didn't convince me to go to graduate school…I think what was different was the fact that I was working on a real research project here.

E. Working on a research project with a faculty mentor provides a forum for collegial interaction with a faculty member

The SaS research project also gave participants the valuable opportunity to interact with professors outside of the classroom. Through their research experiences, participants developed the ability to discuss topics on a more sophisticated and better-informed level than they had as mere students in a classroom. As a result, many felt that they were able to interact with faculty members in a collegial way for the first time in their academic careers. This gave them the confidence to approach professors and discuss research topics even after the summer had ended. One graduate student, who said he wouldn't have been involved in research his first couple years if it weren't for the SaS program, described how his SaS research experiences affected his relationships with faculty members in his department:

> What SaS has done to me is expose me to the research part of graduate school. Not just the actual research, but also the professors…Normally you would only see them in the classroom. And you know that they're in a certain field, and you get to know them a little better in graduate school than you had as an undergrad, but even in graduate courses you don't know them that well because what they're really here for is the research…As a first-year graduate student [in fields like applied mathematics], you generally don't work with them…But now it's like I'm actually working with them. And it's like, I go and I meet with my advisor and we talk about math. The latest in math. It's very different from class-related interactions.

5. Conclusion

The evidence in this document establishes the success of the Summer with a Scientist program with respect to the recruitment of minority undergraduates into graduate school and the retention of minority graduate students at Rice University. Tracking of student academic outcomes, and

interviews and surveys with student participants demonstrated not only that SaS participants are enrolling in graduate school and obtaining graduate degrees at an unusually high rate, but that most of these participants feel the program had a powerful impact on their decisions about and success in pursuing advanced degrees. A number of them asserted that they would not have completed their degrees—or thought to enroll in graduate school at all—had it not been for their participation in the Summer with a Scientist program.

In our analyses of survey and interview data, we have sought to identify the essential elements that were critical in bringing about the remarkable success of the SaS program. Because of the interest in replicating this program at other sites, we attempted to determine what characteristics of the program director, the student community, and the research project would likely have to be present in order to bring about similar outcomes in other institutional and departmental contexts. In short, we have attempted to provide guidelines for how to replicate this program at a department that is not associated with the CRPC, a University that is not Rice, and a program director that is not Dr. Tapia. The three lists of essential elements should be seen as hypotheses about what is needed for a similar program to succeed in another context. These hypotheses remain to be tested through replication.

Those wishing to replicate the success of the SaS program should keep in mind that the essential elements of the SaS program delineated here do not work in isolation but rather interact with each other to produce the desired outcomes. Also, this list of elements should be seen as a guideline for what to aim for in constructing a similar program in another departmental or institutional context, not as an unalterable blueprint. Failing to incorporate one or more of these elements may weaken the new program's chances for success, but not necessarily, and contexts very different from those at Rice may require that some elements not included on this list be added in order to achieve success. Until similar programs incorporating most or all of these essential elements are instituted in other departments or at other universities, our knowledge of the adaptability of the SaS program and the weight to be given to each of its "essential" elements remains incomplete.

Finally, although the results of this evaluation have shown the Summer with a Scientist program to be remarkably successful at achieving its stated objectives, readers should note that such favorable outcomes have taken many years to achieve. It is rare for a program to show successful outcomes in its first year or two, especially when the program is one that is being adapted for use in a new context. The process of determining the unique benefits and constraints of a new context and adapting to those constraints takes time. Those wishing to achieve success as quickly as possible are advised to incorporate formative evaluation and tracking of program participants into their program from the very start. The program administrators must then be willing to use this formative feedback to make whatever refinements and adjustments are necessary. In the end, those programs whose administrators are both patient and flexible will achieve the greatest success.

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Appendix A: Protocol Questions for SaS Participants who are currently in Graduate School

Background

I'd like to ask you some questions about your background.

I. What year are you in your graduate program?

II. What department are you in?

III. What undergraduate school did you attend?

IV. Describe for me what led you to your field of study. What kinds of things do you like about your research area? Dislike?

V. Describe for me what led you to choose Rice for graduate school. What kinds of things do you like about your department at Rice? Dislike?

VI. What do your parents do? What is their educational background? What do your sisters/brothers do?

VII. Describe for me how your family and friends feel about what you are doing now.

A. How does your family feel about your being in graduate school and your field of study? How about your friends from high school? How are they supportive of you? Are there things they do or say that may be negative about what you are doing?

B. Tell me about how your family feels about the value of education. Does it differ from your views?

Departmental Questions

I'd like to ask you some questions about your department at Rice.

I. Where are you in your graduate program? Are you taking classes? Have you taken your qualifying exams? Are you a dissertator?

II. What degree are you pursuing? Why would you like to pursue that degree?

III. Do you receive any financial support? If so, what kind? Has this changed as a result of your being in the SaS program? What kinds of support are available? What kind of support would you most like to have and why?

IV. Do you have a research advisor? If so, how often do you meet with your advisor? What kinds of things do you talk about? How comfortable are you talking with him/her? Have you attended any conferences with him/her? Has the SaS program influenced how you found your advisor and/or how you interact with him/her?

V. What is your department like?

A. How would you describe the atmosphere there? [PROMPT: competitive v. cooperative] Do you like the atmosphere?

B. What is the gender composition?

C. What is the minority composition?

VI. Do you feel a part of the department? Have you always felt this way? Has the SaS program had an influence on how integrated you feel in the department?

VII. Do you interact with other graduate students in your department? In what ways? How often? How has the SaS influenced this, if at all?

VIII. Do you interact with faculty in your department? In what ways? How often? How has the SaS influenced this?

A. Are there any faculty members in your department whose interactions you find valuable?

B. Are there any you would consider mentors or role models? If so, why?

C. Has the SaS program influenced this?

IX. Are there seminars in your research area? Do you attend those? What are they like? Do students give talks in these seminars? Have you given a talk in these seminars? Has the SaS program influenced this?

X. Are you on any graduate committees in your department? Has the SaS program influenced this?

SaS Overall Program Questions

I. Now I'd like to ask you a few questions about your overall experience in the SaS program.

II. Is this your first year in the program?

A. If no, how many times have you participated in the program? Have you participated in the program as an undergraduate?

III. Why did you choose to participate in SaS program? How did you hear about this program? Did you apply to any other summer programs? Have you participated in any other summer programs?

A. [**If multiple years**] Did your motivation to participate change over time?

IV. Looking back on your experience in the SaS program, what kinds of things made the program work for you? What did you like about the program? Were there things about the program that could have been changed to make the program work better for you?

V. Do you do or approach things differently as a result of your experience in the program?

A. Has your interaction with other graduate students changed?

B. Has your interaction with faculty in your department changed?

C. Has your research interest or motivation changed?

D. Has your commitment to graduate school changed?

SaS Specific Questions

Now I'd like to talk to your about specific SaS program elements.

I. Do you currently do research during the school year?

A. If yes, Is this independent or a part of your graduate program? How is this related to your research project in the SaS?

1. Do you enjoy doing research? What do you like about it? What do you dislike?

2. How did you get involved in this particular research project? Was the SaS program a factor?

3. Who answered your questions about your research?

B. If no, How did you get started on your research project? Describe how you ended up working on what you did. [PROMPT: Who decided what you would work on? How did your project fit in with the mentor's research? Was your research part of a larger project?]

1. What is it like doing research?

2. Do you enjoy working on this research project? Why or why not? Would you have liked anything to be different?

3. When you have questions about the research project, who do you turn to?

C. [**If multiple years**] Did this differ in other years?

II. Did you give any talks this summer? Describe them for me. How did they go? What helped you to prepare for them?

III. What kinds of things does your faculty mentor or advisor do in the program?

A. What is your mentor like?

B. How often did you see your mentor? [Prompt: In what contexts?]

C. Was this what you expected?

D. When you meet with your mentor, what sort of things do you talk about?

E. [**If multiple years**] Did this differ in other years?

F. Have you been in contact with your faculty mentor since you've been out of the program? If so, what kinds of contact? How often?

IV. Tell me about your interactions with Dr. Tapia. What kinds of things do you talk about? What was the value of those interactions, if any? Does it matter to you that he is a minority? Why or why not? Have you been in contact with him since the program ended? If so, what was the nature of it? How valuable is that contact to you?

A. [**If multiple years**] Has your contact with Dr. Tapia changed over the years?

V. Tell me about your interactions with other SaS students. How did you meet them? What kinds of things did you talk about? What was the value of those interactions, if any? Did it matter that they were minority students?

A. [**If multiple years**] Did your interactions with students differ over the years?

VI. Tell me about your meetings with the other SaS students and Dr. Tapia. What did you do in these meetings? What was the value of those meetings, if any? What did you like about them? Is there anything you disliked about them?

A. [**If multiple years**] Did the value of those meetings change for you over the years?

VII. Did you interact with any non-SaS students that summer? How did you meet them? What kinds of things did you talk about? What was the value of these interactions?

VIII. Tell me about the mentoring you did over the summer. What did you like or dislike about it? What was the value of it, if any?

A. [**If multiple years**] Did this differ in other years?

IX. Is there anything else about your experience in the program that you would like to comment on or discuss?

X. Now that we've discussed the program in detail, how would you characterize the impact of this program on you? [Prompt: Has it influenced your career plans, your research plans? How?]

A. [**If multiple years**] Did the program impact you differently in other years?

Future Plans

I. What would you like to be doing 5 years from now? How has the SaS shaped that goal, if at all?

II. What would you like to do with your graduate degree? Has your experience changed your feelings about pursuing a your degree or what your will do with your degree?

General

I. Is there anything you feel we haven't talked about that is relevant to the SaS program and your graduate school experience?

Appendix B: Survey of Participants in Rice's Summer with a Scientist Program

This survey will enable administrators of the Summer with a Scientist Program to understand its impact on the students who have participated in it over the years and will provide valuable feedback on what aspects of the program need improvement. The first page asks about background information and what you are doing now; the remaining pages ask about your experiences in the program. Please take some time to fill out this survey and return it in the enclosed envelope. We appreciate your time and effort in helping us to improve and expand this important program.

(1) Your name: _____

(2) Race/ethnicity:_____

(3) Year(s) you were in program (e.g., 1991-1994): _____

(4) Year in school just completed when you first entered program:_____

(5) Your undergraduate institution(s):_____

(6) Your undergraduate major(s): _____

(7) Your overall undergraduate GPA:_____

(8a) Have you received your baccalaureate degree? (circle) yes no

b) In what month and year was/will that degree be received?_____

(9) What is the highest degree you plan to pursue? ___BA/BS ___Masters ___PhD ___Prof degr

(10) How and where, if anywhere, are you currently employed?_____

_____

Answer questions 11-15 only if you have graduated from your undergraduate institution:

(11) What did you do in the year immediately after graduating?_____

_____

(12) How many graduate/professional schools have you applied to? _____ …been accepted to?_____

(13a) What type of advanced degree program(s), if any, have you enrolled in? (check all that apply)

___Masters ___PhD ___MD ___JD ___DDS ___DVM ___Other:_____

b) If you have enrolled for an advanced degree, please indicate where and in what program/department:

_____

c) If you have <u>not</u> enrolled for an advanced degree, how likely is it that you will eventually?

___Very likely ___Somewhat likely ___Not at all likely

(14) Have you already received any graduate or professional degrees? (circle) yes no

a) If <u>yes</u>, indicate the degree you received and the year you received it (e.g., M.S. Forestry, 1994):

_____

(15) <u>If you are currently a graduate student</u>, which of the following, if any, have you completed so far?

___ First-year coursework ___All required coursework ___Masters thesis
___ Qualifying exams ___Research for dissertation ___Draft of doctoral thesis

Instructions: Please check the one most appropriate response unless otherwise indicated. If you participated for more than one year, answer year-specific questions for the first year you participated.

(16) How did you first hear about the Summer with a Scientist program?

____Dr. Tapia told me about it at a conference, fair, or campus seminar
____I heard it described in a talk or presentation
____I heard about it from my mentor or guidance counselor
____I heard about it from a former or current participant
____I saw a poster or flyer describing the program
____I found information on the Web about it

Other:_____

(17) What were your reasons for enrolling in the program? (Check all that apply, then mark the most important or influential reason with a "#1")

____Dr. Tapia encouraged/convinced me to enroll
____An mentor, guidance counselor, or professor other than Tapia encouraged me to enroll
____Students who were already in the program encouraged me to enroll
____I wanted to be a part of the support community that I saw/heard about there
____I wanted to learn more about my field and what the research/career options were
____I wanted to gain experience doing research
____I wanted to get an idea of what being a graduate student would be like
____I wanted to receive guidance in professional development issues
____I was already interested in Rice for graduate school and wanted to see for myself what it was like there
____I hoped it would improve my chances of getting into graduate/professional school
____I needed something productive to do over the summer that would pay room and board
____It is something that most minority and female graduate students in my department do
____Other:_____

(18) *If you were already a graduate student at Rice when you entered the program, skip to question 19*

a) Prior to entering the summer program, how interested were you in attending graduate school?

____Very interested
____Fairly interested
____Only if other choices didn't pan out
____Not at all interested
____Hadn't really thought about it

b) Prior to entering the program, how interested were you in attending grad school specifically at Rice?

____Very interested
____Fairly interested
____Only if other choices didn't pan out
____Not at all interested
____Hadn't really thought about it

c) After your first summer in the program, how interested were you in attending graduate school?

____Very interested
____Fairly interested
____Only if other choices didn't pan out
____Not at all interested

____Hadn't really thought about it

d) <u>After</u> your first summer in the program, how interested were you in attending grad school specifically <u>at Rice?</u>
____Very interested
____Fairly interested
____Only if other choices didn't pan out
____Not at all interested
____Hadn't really thought about it

(19) How did you select your mentor your first summer in the program? (Check all that apply)
____I asked for Dr. Tapia's advice on who would make a good mentor
____Dr. Tapia or someone in the program chose an mentor for me
____I had taken a course with my mentor and thought he/she would be good to work with
____I picked the mentor who was doing research in the area closest to my area of interest
____I asked fellow students and program participants about professors they knew
____I was assigned to a graduate advisor and used the same person as my summer mentor
____Other:_____

(20a) Rate your satisfaction with the interactions you had with your mentor.
____Highly satisfied
____Fairly satisfied
____Somewhat dissatisfied
____Very dissatisfied
b) Explain why you felt that:_____
_____
_____

(21) What type of interaction did you have with this mentor after the summer was over? (Check all that apply)
____I had little or no interaction with this mentor after the summer was over
____I continued to stay in touch with him/her through the phone, email, or conferences
____I took a course from this mentor in graduate school
____I would go to talk to him/her in person about classes, research, or other topics
____I continued to work on research with this professor during the school year
____My summer program mentor became my major professor/advisor in graduate school
____My summer program mentor eventually served/will serve on my thesis committee

(22) Using the scale below, please indicate how the following elements of the summer program influenced your <u>desire to attend or remain in graduate school</u>.

decreased greatly	decreased somewhat	no change	increased somewhat	increased greatly
-2	-1	0	+1	+2

a)____The experience of doing research in a university setting
b)____ The interactions I had with my mentor
c)____The Friday discussions about professional development issues
d)____The Friday discussions about issues of race and ethnicity
e)____The interactions I had with Dr. Tapia
f)____The interactions I had with other students in the program
g)____The experience of mentoring high school students
h)____Giving presentations to teachers in the summer workshop
i)____Being in the company of other minority students
j)____The program overall

(23) Using the scale below, please indicate how the following elements of the summer program influenced your feelings of belonging to a community.

decreased greatly	decreased somewhat	no change	increased somewhat	increased greatly
-2	-1	0	+1	+2

a)____The experience of doing research in a university setting
b)____The interactions I had with my mentor
c)____The Friday discussions about professional development issues
d)____The Friday discussions about issues of race and ethnicity
e)____The interactions I had with Dr. Tapia
f)____The interactions I had with other students in the program
g)____The experience of mentoring high school students
h)____Giving presentations to teachers in the summer workshop
i)____Being in the company of other minority students
j)____The program overall

(24) Using a scale from 0 (none) to 4 (very high), please indicate the degree of impact that each of the following elements of the summer program had on your preparedness for graduate/professional school.

no impact				very high impact
0	1	2	3	4

a)____The experience of doing research in a university setting
b)____ The interactions I had with my mentor
c)____The Friday discussions about professional development issues
d)____The Friday discussions about issues of race and ethnicity
e)____The interactions I had with Dr. Tapia
f)____The interactions I had with other students in the program
g)____The experience of mentoring high school students
h)____Giving presentations to teachers in the summer workshop
i)____Being in the company of other minority students
j)____The program overall

(25) Using a scale from 0 (none) to 4 (very high), please indicate the degree of impact that each of the following elements of the summer program had on your preparedness for a career in your field.

no impact				very high impact
0	1	2	3	4

a)____The experience of doing research in a university setting
b)____ The interactions I had with my mentor
c)____The Friday discussions about professional development issues
d)____The Friday discussions about issues of race and ethnicity
e)____The interactions I had with Dr. Tapia
f)____The interactions I had with other students in the program
g)____The experience of mentoring high school students
h)____Giving presentations to teachers in the summer workshop
i)____Being in the company of other minority students

j)____The program overall

(26) What part/aspect of the program did you value most and why?_____
_____
_____
_____

(27) If you could change something about the program, what would it be and why?_____
_____
_____
_____

(28) To what degree did the summer program affect your confidence in the following areas? Use the scale below.

decreased greatly	decreased somewhat	no change	increased somewhat	increased greatly
-2	-1	0	+1	+2

Confidence in…
a)____doing research
b)____handling graduate-level work
c)____approaching & interacting with faculty
d)____getting into graduate/professional school
e)____mentoring other students
f)____giving presentations/talks
g)____discussing controversial topics in a constructive way
h)____completing your degree
i)____succeeding in your career
j)____general (overall confidence)

(29) In considering a graduate or professional school, what factors were/are you considering? Place a 1 in front of factors that were of primary importance and a 2 in front of factors that were of secondary importance. If a given factor is not important to you, leave that space blank.

1 = primary, 2 = secondary, blank = not important

____A high national ranking/good reputation in your area of interest
____The presence of noted faculty members you hope to work with or learn from
____Well-equipped labs, libraries, and computer facilities
____Reliable financial support from fellowships, research assistantships, and other grants
____Accessible and approachable faculty
____The demeanor/interests/approachability of the graduate students in the department
____A sufficient number of minority students and researchers
____A friendly and comfortable living environment
____Easy access to your favorite cultural and recreational activities
____Geographical closeness to family and the place you call “home”
____Respect for diversity within the surrounding community
____Other:_____

(30) In your opinion, how does Rice University rank on each of these factors for your area of interest? Enter a "P" for a positive ranking, an "N" for a negative ranking, and a "0" for a neutral ranking.

____A high national ranking/good reputation in your area of interest
____The presence of noted faculty members you hope to work with or learn from
____Well-equipped labs, libraries, and computer facilities
____Reliable financial support from fellowships, research assistantships, and other grants
____Accessible and approachable faculty
____The demeanor/interests/approachability of the graduate students in the department
____A sufficient number of minority students and researchers
____A friendly and comfortable living environment
____Easy access to your favorite cultural and recreational activities
____Geographical closeness to family and the place you call "home"
____Respect for diversity within the surrounding community
____Other:_____

If you are not a graduate student, skip to question 33.
(31) In your experience as a graduate student so far, what has been the effect of the following factors on your desire to remain in graduate school and complete your degree? Enter a "P" for a positive or encouraging effect, an "N" for a negative or discouraging effect, and a "0" for no effect. Then, place an "X" by the factor that was most encouraging and another "X" by the factor that was most discouraging.

____Interactions with your advisor/major professor
____Interactions with other faculty members in your department
____Interactions with non-minority graduate students in your department
____Interactions with minority graduate students in your department
____Your financial situation
____Your workload
____Your work environment (office space/location, availability of computers/resources)
____Your experiences with classes and coursework
____Your research experiences during the school year (non SaS)
____What you have learned about your field of interest and its career paths
____Your career aspirations
____Your experiences in the Summer with a Scientist Program
____The number of minority students and researchers in your department or related departments
____Your living situation and community surroundings
____The way minorities are treated in the department and university
____The way minorities are treated in the surrounding community
____Family/personal situations

(33) What kind of financial support have you had as a graduate student? (Check all that apply)

___TA-ship ___RA-ship ___PA-ship ___Fellowship ___Loan

(34) What influence, if any, has the Summer with a Scientist program had on your feeling that you belong in your department?

____It has made me feel more integrated
____It has made me feel less integrated
____It has had little or no effect

(35) How important do you think it is that the summer program include students who have been in the program a number of years?
____Critically important
____Very important but not critical
____Somewhat important
____Of little or no importance

(36) How important do you think it is that summer program both graduate and undergraduate students?
____Critically important
____Very important but not critical
____Somewhat important
____Of little or no importance

(37) How important do you think it is that the summer program be led or significantly contributed to by a respected professor who is a minority?
____Critically important
____Very important but not critical
____Somewhat important
____Of little or no importance

(38) How important do you think it is that students write a paper on their research at the end of the summer?
____Critically important
____Very important but not critical
____Somewhat important
____Of little or no importance

(39) In your opinion, what would be the best demographic composition for the Summer with a Scientist program?
____Minority students only
____Should allow some non-minority women, but not non-minority men
____Should allow both male and female non-minorities as long as their percentage remains small
____Should include an equal number of minority and non-minority students
____Should enroll students without regard to race or gender

(40) Is there a mailing address at which we can reach you in the future? (For tracking purposes only)
_____
_____
_____