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BASE (Broadening Access to Science Education): A Research and Mentoring Focused Summer STEM Camp Serving Underrepresented High School Girls

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Abstract

BASE (Broadening Access to Science Education) Camp is a hands-on, two-week residential summer science experience on the Fairfield University campus in Fairfield CT, USA. The annual program targets 24 young women who attend high school in the neighboring city of Bridgeport, CT, the most economically depressed city in CT. The camp, which is free to students, includes three components. The first is the week-long Research Immersion Experience, which engages students in faculty-mentored science research projects assisted by current undergraduate STEM majors. The second component is Career Exploration, which allows students to explore a variety of careers in science, technology, and healthcare, as well as the academic paths required to get there. The third component is College Admissions Counseling, which links campers with Fairfield University's undergraduate admissions staff for guidance on the college application process. This program is particularly unique in that it rests entirely on a female staff, engaging Fairfield University's women STEM faculty and undergraduate STEM majors. BASE Camp was founded and developed through funding from several organizations, most recently through a five-year R25 grant from the NIMHD (National Institute on Minority Health and Health Disparities), National Institutes of Health. After four years in this format, the program engaged close to 100 young women, and pre/post-camp survey data showed a significant increase in camper self-perceived confidence in science, understanding of the scientific process and science skills, awareness of STEM and health career paths, and understanding of the college admissions process. A follow-up survey showed 95% of respondents had applied to, or planned to apply to, college, and 87% stated an interest in pursuing a STEM or health-related career. The close mentorship of these young women by female role models at the faculty and undergraduate levels has greatly contributed to the success and efficacy of this experience. The authors hope this program can be used as a model for others to create programming in an effort to promote and support underrepresented women in the pursuit of STEM careers.

Introduction

Adequate exposure to science content and the excitement of scientific inquiry throughout the high school years are important factors in attracting students into the sciences, and ensuring the success and retention of these students in STEM (science, technology, engineering and math) in and after college (National Research Council, 2011). Summer camps and experiences are often a great way for students to connect meaningfully with scientific experiments and concepts for which there is not enough time during the school year (Exstrom, 2000, Ahrenkiel, 2014, Donnelly, 2016). There is much evidence that active hands-on learning and laboratory experiences improve persistence of students in STEM majors (President's Council of Advisors on Science and Technology (PCAST) 2012). These experiences are particularly important for students in urban areas, where underfunded science curricula and limited access to role models and mentors in STEM and health careers are common. Data show that early interest in science in K-12 correlates with a student's desire to major in science in college (Museus, 2011). Since STEM careers continue to correlate with higher salaries, and encompass some of the fastest growing sectors for employment, the cost of underrepresented students not being engaged in STEM opportunities is very real, further contributing to economic inequity in our nation.

The impact of poor high school preparation on student performance has been evident at Fairfield University, a private comprehensive Jesuit institution in Fairfield, CT. The science departments within the College of Arts & Science (Biology, Chemistry & Biochemistry, Physics, Mathematics, and Psychology) have good success attracting and retaining STEM students from the "traditional" student body. Many of these students have been educated in private high schools with considerable exposure to science instruction and laboratory methodology, as well as mentoring support both in school and at home. Fairfield University's STEM retention rate among non-underrepresented groups is 50%, similar to the national average. However, within the underrepresented/minority student population, its STEM retention rate is only 30%. In particular, students coming from poor urban areas lack adequate pre-college science exposure and mentor-

ing and are often lost by the STEM disciplines because of poor performance. According to a 2014 report, Blacks, Latinos, and Native Americans make up about 30% of the U.S. population, but are highly underrepresented at all education levels in STEM fields (Wilson, 2014). Minorities only earn about 7% of the STEM doctoral degrees in the nation (Wilson, 2014). Enriching the science experiences for these students in the high school years is crucial to increasing their entry into the science pipeline and to improving their preparedness for success in college and in STEM careers.

In contrast to Fairfield University's location within Fairfield county, one of the wealthiest counties in the country, the neighboring city of Bridgeport is a poor community, where 95% of students are minority status and 99% qualify for a reduced or free lunch program (Public School Review, n.d.). The number of Bridgeport residents who have earned college degrees is much lower than other parts of the state. For example, only 17% of adults over the age of 25 in Bridgeport have attained a Bachelor's degree or greater, as compared to 37% statewide and 62% in Fairfield (Bridgeport CT Education Data, n.d.). Furthermore, the number of Bridgeport high school graduates entering college after graduation is low, with only 38% of students in Bassick and Harding High schools enrolling immediately after completing their degrees, compared with 80% of graduates in the town of Fairfield (Connecticut State Department of Education, 2016). High school science performance on standardized tests in Bridgeport is also depressed. In 2014, only 38% of 10th grade students in the district performed at or above proficiency, compared with 94% of Fairfield public school students (BraTan, 2015). Unfortunately, underachieving schools do not set students up for success in science-related professions. In a recent study, two of the major factors influencing introductory science course grades in college were demographics such as race and parent education level, as well as high school science experiences (Tai, Sadler, & Mintzes, 2006). In addition, persistence in STEM throughout college is significantly lower for African-Americans and Hispanics, correlating with a variety of pre-college factors including rigor of high school curriculum, parent education, and family income (Anderson, Eugene, & Kim,

2006). There is also significant evidence that minority students have lower self-efficacy in science and mathematics as compared to white students (Leslie, McClure & Oaxaca, 1998; Stevens, 2004). Together, these data confirm the importance of high school programs that specifically engage underrepresented students in STEM programming to build confidence and competency in science and math.

To address the STEM recruitment/retention issues in the neighboring community, an innovative summer program was developed entitled BASE camp (Broadening Access to Science Education). BASE camp is an annual two-week residential summer science program for 24 rising juniors and seniors from Bridgeport and surrounding urban communities. The program specifically targets young women based on the disproportionate underrepresentation of women in science careers and the institutional commitment to promoting women in science at Fairfield University. The camp engages young women in faculty-mentored laboratory research and peer mentoring with the goal of increasing confidence in STEM for future pursuit of STEM majors and careers. The camp includes a one-week research experience, and an additional week of career exploration, college admissions counseling, and final research presentations. A noteworthy and unique feature of this program is the all female staff, which contributes to the close mentoring by female role models at the faculty and undergraduate levels. Because the camp is free to students, and due to the large staff and residential component, BASE camp is expensive, costing approximately \$79,000 annually. From 2012 to 2016, this program was funded by an R25 grant received from the National Institute of Minority Health & Health Disparity, from the National Institute of Health. This program offers a depth and breadth of experience to excite and inform students about the process and promise of science.

Program Description

Many programs across the country have shown that involving underrepresented students in some form of research or inquiry early in their high school or college education can be a key to success in STEM fields (Nocera, 1996, Gaglione, 2002, Fakayode, 2014, Goeden, 2015). In one study that compared the experiences of women and men, women were more likely than men to indicate that being involved in research as undergraduates was a key reason for entering graduate school (Harsh, 2012). In addition to these empirical data supporting the benefits of a research experience, Vygotsky proposed a theoretical model of learning and development known as the Zone of Proximal Development (ZPD), in which a student's potential for development can be increased by support from more advanced students and/or faculty while working on complex tasks (Vygotsky, 1978 and Chaiklin, 2003). The ZPD theory suggests that a student can achieve more in terms of learning and development when working with

	Sun	Mon	Tues	Wed	Thurs	Fri
WEEK 1	Camper Check-in 4-5:00pm Welcome Dinner 6:30pm	Research 9:30am-4:00pm	Research 9:30am-4:00pm	Research 9:30am-4:00pm	Research 9:30am-4:00pm	Research 9:30am-4:00pm Camper Check-out 4-5:00pm
WEEK 2	Camper Check-in 4-5:00pm	FIELD TRIP Bridgeport or St. Vincent's Hospital Presentation Preparation 2-4:00pm	Presentation Preparation 9:30AM-noon Health Careers Exploration 1-5:00pm	Presentation Preparation 9:30AM-noon College Admissions Counseling 1-4:00pm Dinner with parents College Admissions Event 7:30pm	FIELD TRIP Boehringer Ingelheim Farewell Dinner 6:00pm	ORAL Presentations 9:30-11:30am POSTER Presentations 3:00-4:30pm Check-out 4:30-5:30pm

Table 1. Camp Schedule

others on a challenge than alone. A large study of university students in a zoology program showed that introducing the students to research with mentored support at the beginning of the program helped students to develop independence and critical thinking skills as the program progressed (Wass, 2011). Likewise, the structure and design of the BASE camp program align with the theoretical model proposed by Vygotsky.

BASE camp is a two-week summer program that runs from Sunday evening through Friday afternoon of two consecutive weeks. The BASE camp schedule is shown in Table 1. The first and most significant component of this program is the Research Immersion Experience. This weeklong scientific research experience is a faculty-led small group project with two current undergraduate science majors serving as assistants. Projects are based on the research expertise of the facilitating faculty, and cover research topics in biology, chemistry, biochemistry, neuroscience, psychology, mathematics, physics, and engineering. During this first week, students become immersed in the research experience, learning scientific methodology, literature research, experimental techniques, data analysis, statistical applications, and presentation skills. NIH funded programs require incorporation of a discussion of research ethics, for which a set of case studies prepared for the Trinity College summer research program is used (Stickle, 2005). Following the formal research activities of the first week, students continue exploring their research topics in the second week through writing, reading, and discussion, with the mentorship of their undergraduate counselors, culminating in formal student research presentations on the last day of the camp.

BASE camp students are often just beginning to show

interest in scientific inquiry, and the act of working on a research project with experts and advanced students may expand their potential for development as researchers, critical thinkers and scientists. According to Vygotsky, social interaction is not only helpful for this development, but it may transform how a person thinks (Vygotsky, 1978 and Chaiklin, 2003). BASE camp students are immersed in learning during the camp, but more importantly, according to the ZPD theory, their potential for further development is enhanced by the camp's design, which includes this Research Immersion component that allows for working side by side with more advanced learners in the field.

The second component of the camp is the Science and Health Careers Exploration, which occurs in the second week. Students are exposed to various careers in science, technology, and health sciences and the required academic paths to get there. This component includes visits from a variety of STEM and health care professionals who meet with the campers in small groups to discuss their own professions and career paths. This set of activities is coordinated in conjunction with the community partner Southwestern Connecticut Area Health Education Center (AHEC), a non-profit dedicated to community health education, preventative healthcare, and workforce development in the Bridgeport area. Careers covered in the experience include scientific research, medicine, pharmacy, dentistry, physician's assistant, physical therapy, occupational therapy, acupuncture, mental health, and nursing. This component also includes field trips to a local hospital, as well as a pharmaceutical company, where campers are given tours of the facilities and an opportunity to speak one-on-one with women health professionals and scientists. In addition, the Fairfield Uni-

DISCIPLINE	RESEARCH PROJECT TITLES
Biology	<ul style="list-style-type: none"> • <i>Programming Cancer Cell Death</i> • <i>Testing Anti-Cancer Compounds on Human Leukemia Cells</i> • <i>How Do Fish Swim?</i> • <i>Understanding How Genes Work Using Nematodes</i> • <i>Evaluating Chemical Agents That Inhibit Bacterial Growth</i> • <i>Investigating Marine 'Invasions' in Long Island Sound</i> • <i>Can Your Cholesterol Levels Alter Your Immune System?</i> • <i>The Effects of Exercise on the Cardiovascular system</i>
Chemistry	<ul style="list-style-type: none"> • <i>Exploring Forensic Scientific Methods</i>
Psychology	<ul style="list-style-type: none"> • <i>Cognition and the Brain</i> • <i>Does Alcohol Consumption During Adolescence Have Long-term Effects on Behavior?</i> • <i>Studying Autism and the Brain</i>
Physics	<ul style="list-style-type: none"> • <i>The Physics of Sports in Slow Motion</i>
Mathematics	<ul style="list-style-type: none"> • <i>The Germain Primes</i>
Engineering	<ul style="list-style-type: none"> • <i>How Our Oceans Move and Why We Care</i>

Table 2. Research Project Descriptions

versity science faculty and students provide mentorship on the courses, skill sets, and other experiences that can support the campers in future professional pursuits, as well as discussion of local and national organizations that promote women and minorities in science.

The final component of the program is the College Admissions Counseling, coordinated in association with the Office of Undergraduate Admissions. Students are educated about a number of issues including the preferred coursework and standardized testing for college admission, information on the college search and application process, essay writing practice, and mock interviews. One of the additional features of this component is parent outreach. During the second week of the camp, campers can invite parents or guardians to join them for dinner, which is followed by an information session where parents are informed about the college admission process and financial aid opportunities, including the university's Bridgeport Tuition Plan, which provides full tuition remission for Bridgeport residents who meet need-based criteria. Inclusion of the parent feature of this program is supported by numerous studies demonstrating that parental involvement can help support minority student success in STEM courses and pathways (reviewed in Museus et al., 2011). This also aligns with ZPD scaffolding theory, as parental guidance and advocacy through this process can ease its difficulty.

While this program targets only 24 campers each summer, it deliberately involves a proportionately large staff - consisting of a director, administrative assistant, six faculty research mentors, twelve undergraduate counselors, and two additional staff positions that are required for state licensure (Assistant Director and First Aid Director). The faculty and counselors are working directly with the campers on a daily basis, making the actual camper/mentor ratio closer to 4:3. This ratio allows for close mentorship both within the research lab setting, and throughout the residential piece of the program. This number of mentors again aligns well with

the learning theory that states that support from more capable peers and adults can help a learner achieve more than would be possible alone (Vygotsky, 1978).

A wide variety of research experiences have been provided for the students over the years that this program has been funded by NIH. Examples of the research topics covered over the years are shown in Table 2.

Advertisement of the camp is conducted in several ways. First, the camp brochure/application is posted on the Fairfield University BASE Camp website (www.fairfield.edu/basecamp) in early spring. Applicant numbers typically range from 28 to over 40. Applicants came from nearly all of the high schools in Bridgeport, including all of the public high schools, some private schools and several technical/vocational schools. The demographic data available for many of these schools demonstrate that these are high need student populations, with large proportions of underrepresented minorities and economically disadvantaged students, consistent with the Bridgeport school district at large. Approximately 80-90% of admitted BASE campers each summer are minority students.

The application for the camp requires several elements. First, campers must complete an application form which requests basic student information but also asks students to rank their top four choices for research projects. This is done since the goal is to match each student with her area of interest. In addition to the application form, students are required to submit an academic transcript, a list of courses for the subsequent academic year, a one-page essay describing their reason for interest in the camp as well as their career goals, and two

letters of recommendation. The Camp Director collects and reviews all of the applications and selects students based on the entire application package, and also ranks their top four choices for research projects to match each student with her area of interest. Since each research team is designed to be the same size, consisting of four campers, two counselors, and one faculty mentor, students cannot always get their top choice in project.

Preparation for the camp is extensive, coordinated mainly by the camp director and administrative assistant. The annual planning for the camp, therefore, relies on a precise timeline of events, which is outlined in Table 3.

The various activities and components of this program are inherently interactive for campers. They are thoroughly engaged in virtually all activities, and gain opportunities (and confidence) to interact with their mentors and professionals throughout the process. Figure 1 shows pictures of some of the key events of the camp, including the week-long research project, site visits, and final presentations. The final poster presentation is the culminating event, and campers are encouraged to invite family and friends to see their work and join in the celebration. Toward the end of this event, campers are awarded with certificates of completion from their faculty research mentor, allowing individual recognition of each student's contributions and accomplishments.

Outcomes

The objectives of this program were to promote interest and confidence in STEM, with the goal of encouraging the pursuit of STEM among these students in and after college. To assess the efficacy of the program to meet the

Month	Activity
January	Selection of Camp Week & Faculty/Staff Recruitment Budget Planning
February	Faculty Planning Meeting Brochure/Application Production and Distribution Camp Advertising (website)
March/April	Facilities Scheduling Room/Meal Reservations Component Planning
April	Camper Application Review State License Application
May	Camper Project Assignment Staff Training
June	Research Project Preparation Collection of Required Camper Paperwork
July	CAMP
August	Camp Assessment Data Analysis
September	Website Update

Table 3. Annual Planning Timeline



Figure 1: Photos from Key Camp Activities. (A) One camper group working in the research laboratory setting. (B) Campers doing hands-on activities on the hospital field trip. (C) Oral presentations on the final day. (D) Poster presentations on the final day. (E) Camper/Staff group photo on the final day.

program objectives, pre/post-camp surveys were administered each year of the camp. The pre-camp survey was administered on the first evening of the camp, following the welcome dinner but before any research or science experiences. The post-camp survey was administered on the final day of camp, following the oral presentations. Questions on both the pre- and post-camp surveys fell into two categories – those that related to interest in certain topics or fields, or those that related to understanding or confidence in certain topics or skills. In addition, there was a set of questions that appeared only on the post-camp survey that asked about each of the specific camp activities. Campers were asked to rate their responses to all questions on the same basic Likert scale:

1 – Strongly Disagree; 2 – Disagree; 3 – Not sure; 4 – Agree; 5 – Strongly Agree. Finally, the post-camp survey

allowed an opportunity for campers to write in what they perceived to be the greatest strengths and weaknesses of the program.

The average post-camp survey results from the first four cohorts of the camp are shown in Figure 2. The four years of survey data show nearly 100% camper satisfaction with the camp experience. It was found that students strongly agree that they have gained scientific knowledge, and that the career exploration and college admission components were extremely helpful.

In order to assess the effectiveness of the various camp components, the pre-camp and post-camp surveys included a number of questions related to science, lab skills, and awareness of science/health careers and college admissions. The composite data from the first four years are shown in Figure 3. The questions fell into two categories on the survey, although they were not coded or categorized as such for the students. One group of questions related to student interest in the academic areas and career fields that were the focus of the camp.

As shown in Figure 3A, camper ratings of interest in college, majoring in science, and science or health careers were very high even at the start of the camp, and did not significantly change after the camp. These data suggest that the recruitment and selection of campers is actually bringing in students with a very serious interest in science in high school, and the program is, therefore, reaching the target audience. While review of transcripts is important in assessing STEM aptitude, the camp director found that the student essay and letters of recommendation were most useful in the selection process. Occasionally there were applicants that expressed a weak interest in science, but these students were typically not selected for admission. Students were also asked about interest in teaching, which is not a focus of the camp, and this was significantly lower among campers, with most disagreeing or strongly disagreeing, and the average response did not change post camp. These data demonstrate that the four cohorts of campers represented the desired target audience, and

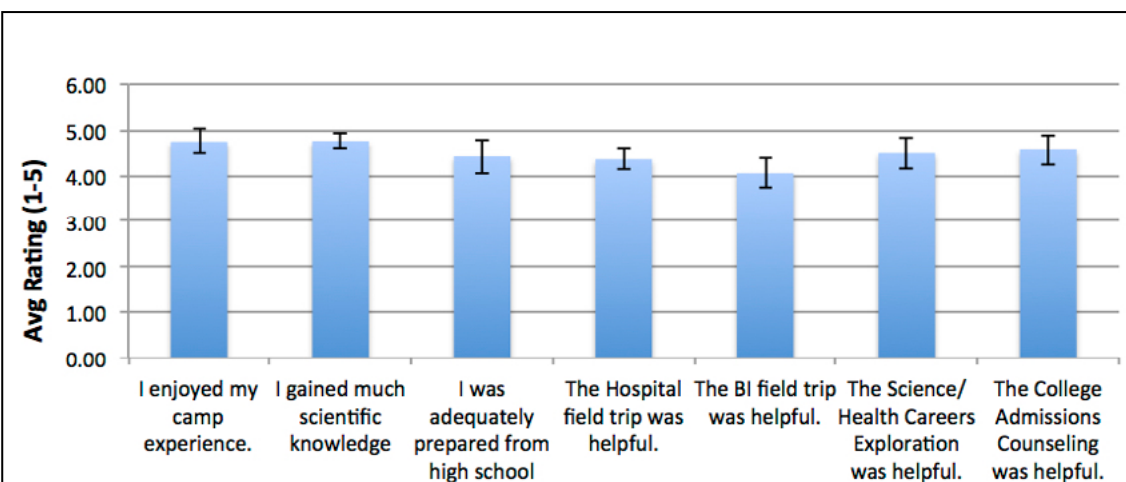
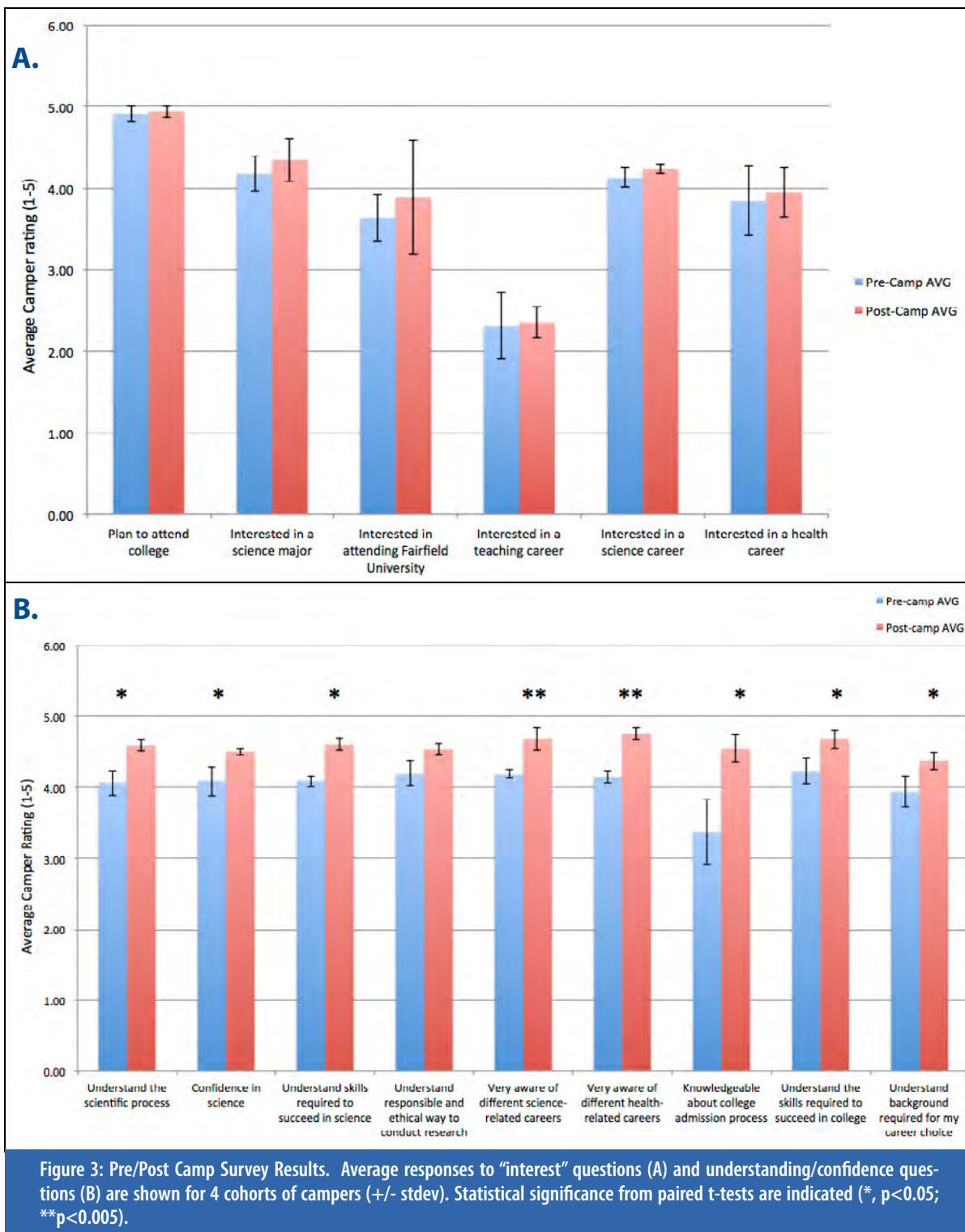


Figure 2. Post-Camp Survey Questions on Efficacy of Camp Components. Averages from 4 cohorts of campers are shown for each question (+/- stdev).



the college admissions component really just comprised one afternoon of work, the authors were excited by the impact of this experience. Testimonials from the campers often included references to this being one of the most informative parts of the experience. Very similar feedback was obtained from parents after the evening parent session on college admissions and financial aid. While formal data were not collected from parents, this event was well attended each year, and parents asked a myriad of questions related to the college applications, essay writing, the relative roles of GPAs and standardized testing, differences between early action and early decision, and the financial aid application process. Together, these data demonstrate that students/families lack understanding of the complicated college admissions process, including the importance and procedure for financial aid, identifying a barrier that is unrelated to student content knowledge, confidence, or interest. This is a critical point, since non-participating students/families likely also encounter this barrier, but without any additional intervention to assist them. To help broaden the reach of this popular part of BASE camp, Bridgeport high school guidance counselors will be invited to this year's parent College Admissions event.

The one item in the second grouping of questions that did not show a significant

difference before and after the camp was the question “I understand the responsible and ethical way to conduct research.”

As an NIH-funded program, it was important to include a component of instruction related to research ethics and misconduct. During the pre-camp staff meeting, the director includes a brief training session with faculty and counselors to review case studies related to ethical issues in research. In turn, faculty and counselors instruct their campers in a format that fits best with the research project. This may include a review of individual case studies, an open discussion, question and answer

that the camp experience did not further enhance, nor diminish, this science/health interest.

The other group of survey questions related to camper confidence in science, or understanding of science/health content, fields, or skills. These questions directly relate to the efficacy of the activities within the two-week program. These data are shown in Fig 3B. While the pre-camp ratings for most of these questions were also quite high, it was exciting to see that the post-camp ratings significantly increased for all but one of these questions. Specifically, increases between 8 and 12% were found for

most of these questions, including confidence in science, understanding the scientific process, and understanding skills needed for success in science. It is clear from the data that the research immersion is effective in building confidence and knowledge about “doing science.”

The authors also saw large differences in camper ratings of awareness of science and health careers before vs. after camp ($p < 0.005$). Interestingly, the largest increase in pre- vs. post-camp data (24%) was found in “awareness of the college admissions process,” which had the lowest pre-camp rating of this group of questions. Since

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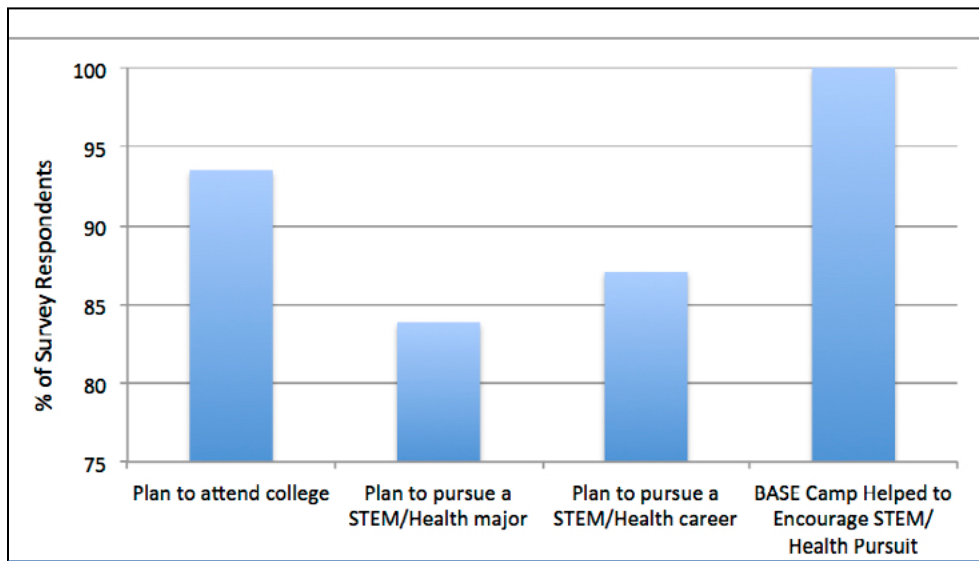


Figure 4. Follow-up Survey Results

period, or activities. Given their very brief exposure to this new and complex topic, the authors were not surprised to see no change in this rating. However, efforts to enhance this component to better illustrate the concept of its importance to students will be a priority for the next iteration of this camp.

On the written portion of the post-camp survey, campers indicated what they perceived as the strengths of weaknesses of the program. One of the most common strengths related to the relationships established with the faculty and undergraduate mentors. This mentorship, which includes academic research mentorship, professional/career mentorship, and peer mentorship, is continued after the camp each year through email correspondence and website updating of additional resources. These mentoring relationships also continue informally each year through one-on-one connections, often through social media, strengthening the bond between campers and counselors. Students noted very few weaknesses of the program, other than its length, which some expressed as being too short.

While the immediate feedback from the camp surveys informs us about the effectiveness of the individual components, the authors were also very interested in the paths that campers take toward college, and whether these young women decide to continue on in science. To gauge this, anonymous follow-up surveys were conducted by email, including a number of questions related to academic and career interests of students following the camp experience. Data are shown in Figure 4 from the 31 respondents. To date, 94% have applied, or plan to apply, to college. It was exciting to see that 84% indicated that they will pursue (or have pursued) a STEM or health-related academic field of study in college, and 87% indicated an interest in pursuing a STEM or health-related career after college. Finally, 100% of survey respondents said that BASE camp helped to encourage them to pursue a career in one of these fields.

In addition to the quantitative data, testimonials were received from campers regarding their BASE camp experience. These include:

“Base Camp has encouraged me to explore other science related occupations. I was also given the opportunity to learn a little bit about the research done by some of the professors. In college I would like to partake in undergraduate research.”

“BASE Camp really taught me to push my limits as a learner. I met new people, got along with my team, and managed to learn more than I ever thought I could. I’ve always loved science, and BASE Camp just contributed to my growth as a student. My counselors and professors all showed me what it’s like to be professional, all while preparing me for what college will be like. Thank you for enhancing my experience, it was one of the best two weeks of my summer.”

“Thanks to BASE Camp I am more knowledgeable about the different areas of Nursing I can do. Since attending BASE Camp, I started to volunteer at St. Vincent’s Hospital because in one of our field trips we took a tour through the hospital and this widened my options.”

“Base camp gave me a new found love and appreciation for science. I’m now the top student in my chemistry class with a year grade of 98%!”

“BASE Camp helped encourage me because I met other girls who wanted to pursue a career in medicine and they were just like me, so I realized if they could do it so could I.”

Of the first four cohorts of BASE campers, 73 are of the age that they have already applied to (or have been admitted to) college. Of these, the authors were thrilled to see that 49 (67%) applied to Fairfield University, with an acceptance rate of 53%. This is much higher than the average admission rate for students from the Bridgeport

school system (34% in 2015). In addition, 24% of applicants were waitlisted, and only 6% were actually denied admission. (The remaining 17% had incomplete applications, for a multitude of reasons.) It is exciting to report that seven of the nine ex-BASE campers currently enrolled at Fairfield University received full tuition scholarships; five need-based scholarships from the Bridgeport Tuition Grant, and two Community Partnership scholarships eligible only to the top student from each Bridgeport high school. This demonstrates both the need and aptitude of the students who participated in the BASE camp program. Even more exciting, seven of the nine enrolled students are now majoring in science, including majors in biology, chemistry, physics, biochemistry, psychology and electrical engineering. The faculty who mentored these students during the camp now have the pleasure of seeing these students among their own undergraduates in their classrooms, and some are among the top students in their majors. Several of these students have been specifically recruited to serve as BASE camp counselors, and have proven to be excellent mentors in these roles. This is especially important since studies have shown that one of the most important variables contributing to ambition and persistence in STEM majors among minority students is support from minority “mentors” in the form of science faculty, undergraduate students, or staff from the same ethnic group (Grandy, 1998).

Some of the major strengths of this program include the unique hands-on research opportunities with faculty, an all female STEM community, academic and social mentorship from STEM-focused undergraduate role models, exposure to viable STEM career options, and tailored and professional college counseling. While the reported data suggest the program is highly effective, the authors are careful to recognize that these are self-reported gains by student participants. The program does not, for example, directly assess particular learning objectives by way of a pre/post camp test or other evaluative measure. Since BASE camp’s objective was not to cover a certain set of topics for mastery, the program was specifically designed without these types of assessments. However, one possible way to address this in the future would be for faculty to evaluate skills and content knowledge by privately rating perceived achievement in these areas. This would help to validate the effectiveness of the program on learning. In addition, efforts to individually track student performance in subsequent STEM courses would be extremely beneficial. Another challenge of the program is reaching and encouraging target student participation in intensive academic programs over the summer. Distribution of camp brochures and applications directly to science teachers in the Bridgeport schools is critical for target student recruitment each year of the camp. As such, close partnerships between higher education institutions and local urban high schools are essential in building this type of programming and expanding op-

portunities for this critical target population. Involvement of science teachers and guidance counselors in the final day of camp presentations would also help to disseminate the program and build contacts. Finally, a significant limitation of the program is its cost and scope, which is often a major obstacle for institutional commitment. At an annual cost of \$79,000 for 24 campers, the per-camper cost is high (approximately \$3300). Institutional efforts to obtain external funding, cost-share mechanisms, and for-credit options for faculty and counselor mentorship offer possible ways to reduce costs for implementation of such programs.

Conclusions

BASE camp is a robust, meaningful experience that excites and informs students about the process and promise of science. The program has engaged over 140 young women since its inception in 2007, and has made a positive impact on the lives of many high school girls from underserved populations that have limited STEM exposure and experiences. Programs that engage high school students in unique STEM experiences will likely continue to play a profound role in recruiting and retaining bright young minds in the ever-important STEM fields. Based on the observed outcomes from this camp, institutions should prioritize programs such as this to engage underrepresented students in hands-on science experiences during the high school years.

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