2.5 HOW THE NWC REU AND OTHER EXTRA-CURRICULAR EXPERIENCES IMPACT UNDERGRADUATES' EARLY CAREER PATHS

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1. INTRODUCTION

The National Weather Center Research Experiences for Undergraduates (NWC REU) program is one of about 170 REU Sites awarded each year by the National Science Foundation in fields of research it funds. Our particular program has existed under six different grants: 1991-1992, 1995, 1998, 1999-2000, 2001-2005, and 2006-2010. NSF funds programs like ours to engage undergraduates in research in meaningful ways because experience in research is one of the most effective ways to attract and retain talented undergraduates in science and engineering careers (NSF, 2009).

Recent evaluations and a separate qualitative study (Gonzalez-Espada & Zaras, 2005) of the NWC REU program have gone beyond whether program elements meet goals to look at how the program impacts participants' career choices. The program clearly affects graduate school plans, with impacts on career plans and participants' ability to see themselves as scientists less clear. More recent evaluations and the referenced study showed that participants' sense of career direction went down because desirable new options were discovered. They also showed that attraction to research was complicated: some were drawn to it, others turned away, and many remained unsure. Ongoing contact with past participants confirms the NWC REU has lasting effects beyond graduate school choices.

This study sought to better understand more generally how the extracurricular experiences of undergraduates affect their later career choices while also seeking to better understand the specific impact of this program. Participants and a comparable set of non-participants from the 2001-2005 application pool were selected because they are likely to be in or close to beginning their careers. A five-question survey was designed seeking the critical experiences that influenced their career paths.

2. METHOD

2.1 *Developing the Survey*

The investigators wanted create a survey that would be concise, yet still gain very meaningful information from participants. Five questions were developed and given to a few individuals without any knowledge of the overarching goals of the study. If the individuals gave responses that were not addressing the specific aim of a question, the questions were slightly reworded to make the responses more valuable to the study. Sample responses were provided for a two of the short-answer questions to give the survey participants a model from which they could compose their responses. These sample responses were thorough in hopes that survey responders would give equally meaningful and detailed responses.

The survey was composed of four short-answer questions and one Likert-scale response regarding the participants' current career satisfaction levels. The majority of the questions were designed to be open-ended so that it would not be possible to preconceive or presuppose the responses. The short-answer style would allow the survey participants the freedom to elaborate on things they felt were important and hopefully reveal some insight into what influenced their decisions. Specifically, the investigators wanted to create short-answer questions that would allow the participants to discuss the critical experiences that led them to their current positions, the particularly positive experiences in their undergraduate activities, and any experiences they wished they could have had. None of the questions were

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required; survey participants could answer as many or as few questions as they wanted. In addition to the open-ended responses, the investigators wanted a more quantitative response from the survey participants that would allow different subsets of survey responders to be compared quantitatively. One of the major things we wanted to know was if experiences in undergraduate extracurricular activities still impacted the activity participants after graduate school and into their careers. Could a common link be found between certain activities and career satisfaction later in life? In the hope of answering this and other questions, a Likert-scale question asking responders to rank their career satisfaction level on a scale of 1 to 10 was added to the survey.

The resulting survey questions are shown below.

1. Please briefly describe your current career/education status.
Example: B.S. in Physics 2005, M.S. in meteorology completed 2007, now working at private sector forecasting company.

2. Please itemize critical experiences that have influenced your education and/or career path starting during or before your undergraduate career.
Example:
- Met a mentor through volunteering at the NWS office near my home after my sophomore year of undergrad
- NWS mentor advised that if I wanted to work for the NWS, I should go to graduate school
- Went to graduate school at University Learn-A-Lot and worked part-time at a private-sector company
- Discovered I would rather work for a private-sector company because of higher pay and no shift work
- Took a job with as a private-sector forecaster with We-Forecast-For-You Company after receiving my M.S. degree

3. If you had a positive experience with an undergraduate extra-curricular opportunity, what made it such a good experience? How did it help you make decisions about your future? Please explain.

4. Are there undergraduate extra-curricular opportunities in which you did not participate that you believe could have positively impacted your graduate school and career decisions? If so, please explain.

5. How satisfied are you with current career? Using the range of numbers 1-10, circle the number that best describes your current level of satisfaction with your current career.

1: Completely Unsatisfied
5: Slightly Unsatisfied
6: Slight Satisfied
10: Completely Satisfied

2.2. *Determining the Cohort Group*

Information on alternates and other competitive applicants is not retained after selection is complete. Re-creating a selection committee to choose the comparison group would have been time-consuming and would not have guaranteed that the same students would be chosen even if the committee had consisted of the same members. To select our comparison group, we began with analysis of the in-major GPA of participants.

An in-major GPA was chosen to include applicants similarly qualified as the participants and yield a reasonable number of applicants to be contacted for this survey. Once the in-major GPAs were comparable between groups and an acceptable amount of applicants were left to be contacted, the cutoff was selected. This cutoff was a 3.5 and resulted in 137 applicants in the cohort group. Because the in-major GPA is most meaningful for students who have taken classes in their major, we considered only junior and senior applicants for this study.

2.3. *Process of Gaining Study Participants*

The survey was sent via email and U.S. postal mail to all 137 in the cohort group and all 53 in the participant group. Contacting past REU participants proved much easier than contacting the cohort group. After sending out the recruitment email to the past-participants email list three times, there was a near 50% response rate. The only available modes of contact for the cohort were their email and home addresses at the time they filled out the application. When sending out the recruitment emails to this non-participant group, most emails bounced back immediately.

Very few of the cohort group initially took part in the survey. Paper surveys were sent to the permanent addresses of the cohort group. A business reply envelope was included in hopes of promoting responses. In addition to the paper surveys, a recruitment letter was also included in the envelope that gave the web address for the online survey. Sixteen were returned as undeliverable. Two were filled out and mailed back; a few likely responded online.

A third attempt was made in early fall to contact the cohort group. Using the list of 137 names, majors, undergraduate institutions, and home addresses at the time of application, several strategies were used to locate an electronic means of contact. Two employer directories proved helpful in locating 17 of the cohort. Another 47 were located either directly or through a mutual "friend" on Facebook, which was used conservatively. If a name match was found on Facebook, but the hometown or school information did not show or match, contact was not attempted. The remaining 47 with apparently valid home addresses were sent a repeat mailing of the solicitation. Three of those were returned as undeliverable.

4. FINDINGS

We asked several questions of our data, hoping to understand what activities the survey responders valued, what influenced their graduate school and career decisions, and what additional experiences they wished they had had. Answers to all survey questions were used to tabulate the most common responses. For each of the questions asked of the data, the most common responses are provided in tables with the most common response at the top. Experiences mentioned by only one responder or by many fewer responders that the most common experiences were not included in the tables.

4.1 *Valuable Undergraduate Extra-Curricular Experiences*

The first question we asked of our data was what undergraduate extra-curricular activities were deemed particularly valuable. All but one responder included an extra-curricular experience as particularly valuable in their education and/or career paths. Ranked lists of the most common responses for cohort group and past participants are shown below in Tables 1 and 2, respectively. The number of responses out of the 28 total for each group that mentioned the experiences is shown in parentheses.

Valued Experiences for Cohort Group *(N=27/28)*
Research experience (17)
Increased clarity regarding ideal careers (11)
Increased skills, knowledge (10)
Networking/Mentorship (10)

Table 1

Valued Experiences for Past Participants *(N = 28/28)*
Increased clarity regarding ideal careers (19)
Networking/Mentorship (14)
Research experience (13)
Exposure to new areas of interest (6)

Table 2

Both groups stated that research experience, networking/mentorship opportunities, and increased clarity regarding ideal careers were experiences they greatly valued. Responders said research experienced helped them determine whether they liked working in research, introduced them to new topics, and allowed them to learn more about their own capabilities. Through networking and/or mentoring, many students said that they made critical contacts (potential graduate school advisors, working professionals, etc.) that helped them in their future decisions. Finally, experiences that gave students chances to try out different careers (volunteer positions at forecast offices, internships at news stations, etc.) helped them learn more about these career paths. From these experiences, the survey responders either learned that they could see themselves in those careers or learned that they really did not want to pursue those career avenues in the future.

In addition to the previously mentioned experiences for the cohort group, many responders also said they achieved an increase in certain skills (programming, forecasting, etc.) that they believed helped them in their later endeavors. Many in this group also stated that their exposure to new research areas helped influence their later decisions.

4.2 *Experiences Leading to Graduate School Decisions*

The most commonly mentioned experiences that lead students to their graduate school decisions are shown in Tables 3 and 4. The number in parentheses next to each of the experiences refers to how many different survey responders labeled that particular experience as the reason they did or did not go to graduate school.

Experiences That Influenced Grad School Decisions for the Cohort Group *(N = 18/28)*
Undergraduate Advisors, Professors (7)
Research Experiences (4)
Internships, AMS Involvement (4)
Interest in Teaching, Research (2)

Table 3

Experiences That Influenced Grad School Decisions for Past Participants *(N=17/28)*
National Weather Center REU (10)
Undergraduate Advisors, Professors (2)

Table 4

Both groups said that their undergraduate advisors or professors played key roles in their decisions regarding graduate school. It was the most commonly cited reason for the cohort group. For participants, the NWC REU was the most commonly cited influence on graduate school decisions. This confirms program evaluations and the previously cited qualitative study (Gonzalez-Espada and Zaras, 2005).

4.3 *Experiences Leading to Career Decisions*

While Gonzalez-Espada and Zaras (2005) and past NWC REU evaluations had indicated a relationship between the NWC REU and graduate school decisions, there has been no such relationship found thus far between the program and career decisions. The experiences most frequently stated as influential to career decisions for participants and the cohort group as shown in Tables 5 and 6, respectively. The number of survey responders who addressed the experiences that led to their career decisions was lower than those of the other questions in the study. This may be because, unlike their undergraduate experiences, the survey never explicitly asked responders to discuss their careers. Also, this could be because some responders were finishing up their Ph.D.s and had not yet begun their careers.

Experiences That Influenced Career Decisions for the Cohort Group *(N=15/28)*
Graduate school experience (6)
Internship experience (5)
Difficult job market (4)

Table 5

Experiences That Influenced Career Decisions for Past-Participants *(N=18/28)*
Graduate school experience (5)
Teaching experience (4)
Unexpected life changes (4)
Difficult job market (3)

Table 6

Graduate school experience was the most common response for both groups. Responses cited making important professional connections, discovering new interest areas, and determining career aspirations. Internship experiences were influential experiences for many in the cohort group. A few of the cohort took non-competitive job placements after their undergraduate degrees because of their internships. The second most common response for participants was teaching experience. As teaching assistants in their degree programs or in other extracurricular activities, these responders all had positive teaching experiences and decided to become educators.

Many responders mentioned difficulties they found when searching for a job. A shortage of available jobs in their area and a very competitive market overall were popular responses. These specific difficulties and any others were grouped into the category ‘difficult job market’.

Many responses from the past participant group addressed life changes (i.e. having children, getting married, and/or moving across the country). These critical experiences affected each responder’s career path differently, sometimes leading them to their ideal jobs and sometimes not.

Note that not all of the study participants attended graduate school. Those that did pursue a graduate degree found the experience important in determining their future career paths.

4.4 *Experiences Students Wished They Had Experienced*

The investigators also looked at what experiences responders most wished they had experienced in their undergraduate extracurricular activities. The responses were varied and the most common ones for each group are shown in Tables 7 and 8.

Experiences the Cohort Group Wished For *(N=19/28)*
Exposure to different careers (5)
REU program outside home university (4)
Exposure to different areas of research (3)
Earlier involvement in research (3)
Information about graduate school (3)

Table 7

Experiences Past-Participants Wished For *(N=18/28)*
Exposure to different careers (5)
An additional REU program (4)
AMS involvement (3)

Study abroad (2)
Programming experience (2)
Forecasting experience (2)
Exposure to other sciences (2)

Table 8

Exposure to different careers and additional research, specifically REU experience, were the most common responses for both groups. The cohort group also believed that having exposure to different areas of research and earlier research involvement in general could have been beneficial. A few members of the cohort also mentioned that they would have liked to have had more information about graduate school – where to apply, what graduate student life is like, etc.

The participant group mentioned a wide variety of different experiences. A few said that wished they had been more involved in their local AMS chapters. Some said that either programming or forecasting experience would have helped them in graduate school or in the job market. Two participants said they thought that having more exposure to different sciences like geology, physics and/or math could have helped them when communicating between disciplines.

4.5 *Career Satisfaction*

In addition to the short-answer responses on the survey, the investigators also asked the responders to rank their current career satisfaction on a Likert-scale from 1 to 10 where a rank of 1 corresponds to a completely unsatisfying career and 10 corresponds to a completely satisfying career. We chose a scale with no middle point so that survey responders would be forced to rate their career as either some degree of satisfying or unsatisfying – not neutral.

Responses to the first study solicitation (participants=24, cohort=6) showed a clear difference in means between the cohort group and past-participants in career satisfaction, with past-participant career rankings being significantly higher. The means became similar after repeated study solicitations raised the total number of responses from the cohort group, suggesting a bias toward dissatisfaction with careers in those who responded first. Most responses were in the 5-10 range with the majority in the 8-10 range. Most of the lowest ratings were from members of the cohort group. Coincidently, the ratings from both groups exhibited a bi-modal distribution. A graph of the response data is shown in Figure 1 and the specific statistics are shown in Table 9.

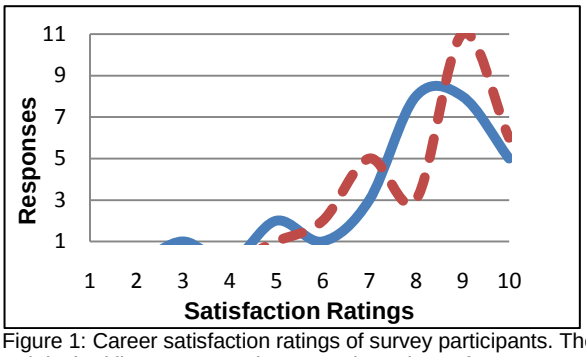

Figure 1: Career satisfaction ratings of survey participants. The red dashed line corresponds to past the ratings of past REU participants and the blue solid line corresponds to the ratings from non-participants.

Career Satisfaction Ratings		
	Cohort Group	Past-Participants
Mean	8.071	8.393
Median	8	9
Variance	2.8834	1.951
Stan. Dev.	1.668	1.371

Table 9

5. LIMITATIONS

While the short-answer format of the survey questions encouraged some responders to provide great detail in their responses, many of the other responses were curt and lacked elaboration. For this reason, it was sometimes difficult to determine the exact implications of each bullet point. Also, because of the format of the survey questions and the example response, many survey responders listed their critical experiences in a bullet point format. This format allowed connections to be made from one step to the next, but did not necessarily encourage the responder to clarify whether an experience affected only the next step in their career or multiple steps.

6. CONCLUSIONS

Both past-participant and cohort groups said they valued the same main undergraduate experiences: experiences that helped to clarify their ideal career paths, networking/mentoring opportunities, and research experiences. The cohort group also valued experiences that allowed them to increase their overall knowledge or skill in a specific area, such as programming or forecasting. Many past participants also said they valued exposure to new areas of research.

The NWC REU was the most cited item impacting the next level of education for past

participants. An overwhelming majority of past participants who clearly addressed what experiences impacted their graduate school decisions said that the NWC REU played a role in their decision. The NWC REU was not directly mentioned in any of the responses regarding career decisions, however. This supports the idea that the program has its largest impacts on the next step after participants' undergraduate degrees. Once participants graduate and move into graduate school or a career, the impact of the NWC REU seems to be outweighed by their experiences in graduate school, a career, and/or unexpected life changes.

Graduate school experiences appeared to be the major factor in career decisions for both groups (with the caveat that we could not go back to clarify whether earlier steps were also impacting that last decision). The responses addressing these important graduate school experiences mentioned particularly positive research experiences, valuable networking opportunities with advisors, or similar experiences.

Both groups said that wish they had been involved with a wide variety of extracurricular activities while in their undergraduate years, but the most common responses were opportunities that provided exposure to possible career fields and REU-like research experiences.

6. ACKNOWLEDGMENTS

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