Who Participates in Undergraduate Research & Creative Activity, and What Have They Learned?

An Analysis of 2012-2017 FUSE Recipients

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CONTENT

INTRODUCTION

How can we encourage research & creative activity among undergraduates? For those who pursue these activities at UNO, what are their experiences like?

When undergraduates engage in research and creative activity, it enriches their college experience and helps them thrive. Several decades' worth of research has examined the benefits that accrue from participation[i]—such as increased retention[ii], greater confidence in their research skills[iii], and increased pursuit of advanced degrees[iv]. While robust, this literature often leans heavily toward natural and applied science fields[v], or examines research and creative activity embedded within a course[vi].

At the University of Nebraska at Omaha (UNO), the Fund for Undergraduate Scholarly Experiences (FUSE) program offers a unique vantage point for exploring the motivations and experiences of students conducting research and creative activity outside of their coursework. Are there disciplinary and gender differences? What insights can we learn about fostering a culture of research on a metropolitan university campus?

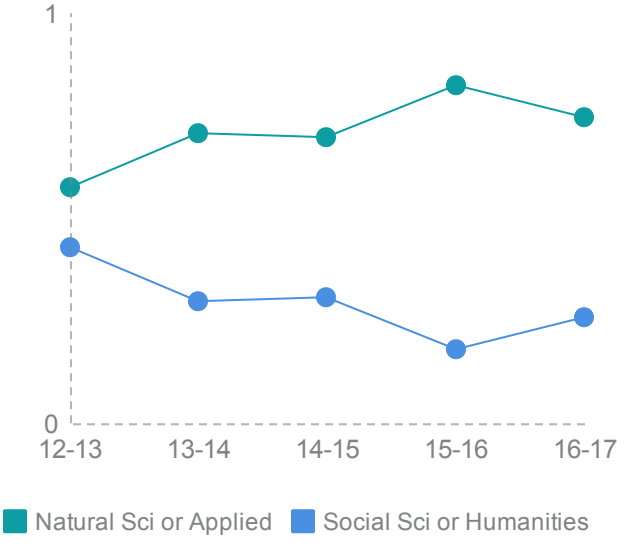
Executive Summary

What can FUSE recipients tell us about undergraduate research and creative activity at UNO? Using 5 years of institutional data about FUSE grant recipients and interview data collected from 19 students awarded a FUSE grant between fall 2013 and spring 2014, we find the following patterns:

Who is awarded a Fund for Undergraduate Scholarly Experiences (FUSE) Grant?

- Between 2012 and 2017, there were 374 FUSE grants awarded. Of these, 70.1% were in the natural or applied sciences, while 29.9% of projects were in the social science or humanities.
- During these five years, the proportion of FUSE grants in the humanities or social sciences experienced a downward trend.
- Among FUSE awardees, men's projects were more likely to be in the natural or applied sciences than the social science or humanities. The trend was reversed for women.
- If the discipline and gender trend patterns continue, women may be less likely to be among the FUSE awardees going forward.

Figure 1. Proportion of FUSE Grants Awarded, by Discipline and Year



What do FUSE awardees say they learned from their experience?

- Most interviewees thought their faculty-student mentor relationship went well.
- When asked "what three qualities do you need to be a researcher?" interviewees most often mentioned persistence and patience. Good work habits came in second, followed by keeping the spark alive (i.e. having passion, ambition, and sense of adventure).
- Even though many mentioned that their research and creative activity experience was not as straightforward or as easy as they thought going into it, they overwhelmingly advised others to "just do it" and apply for a FUSE.
- Interviewees saw many benefits from participating in FUSE. They reported greater self-awareness of their own capabilities and skills (especially women), improved marketability, and felt intrinsic satisfaction.
- They also saw many societal benefits. Most interviewees mentioned that research and creative activity improved society, but many also said these endeavors advanced public and academic knowledge.

"There's so much satisfaction in research, personally. Because you feel like you're doing something that contributes to health and knowledge worldwide. You're contributing something to your society. You're giving back. I've always felt that was really important.... I just think it's the right thing to do. As a global citizen, people should give back to their society. And I think science is the way I know how to do that. And it's the way I feel right doing it. "

Who Receives a FUSE grant?

Gender & Discipline Trends: 2012-2017

The gender composition of FUSE awardees has varied over the past five years. While men outnumbered women for two of the years, women were awarded more FUSE grants one year, and there was parity or close to parity for two of the years.

Out of 374 FUSE grants awarded during this time, there were consistently more grants given to projects in the natural sciences or applied disciplines than in the social sciences or humanities.

Figure 2. FUSE Grants Awarded, by Gender & Year

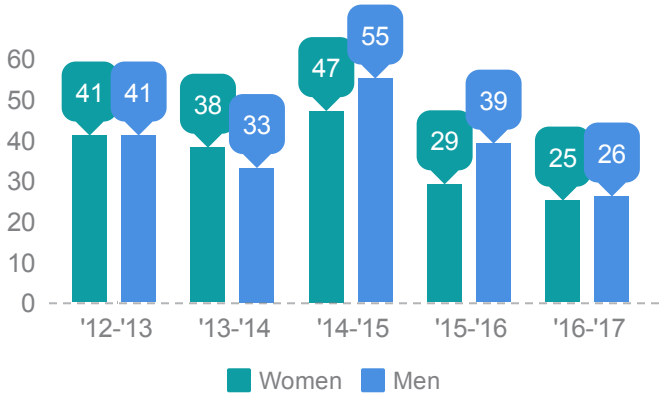
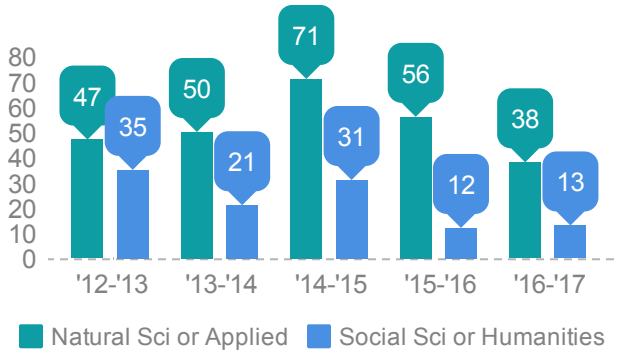
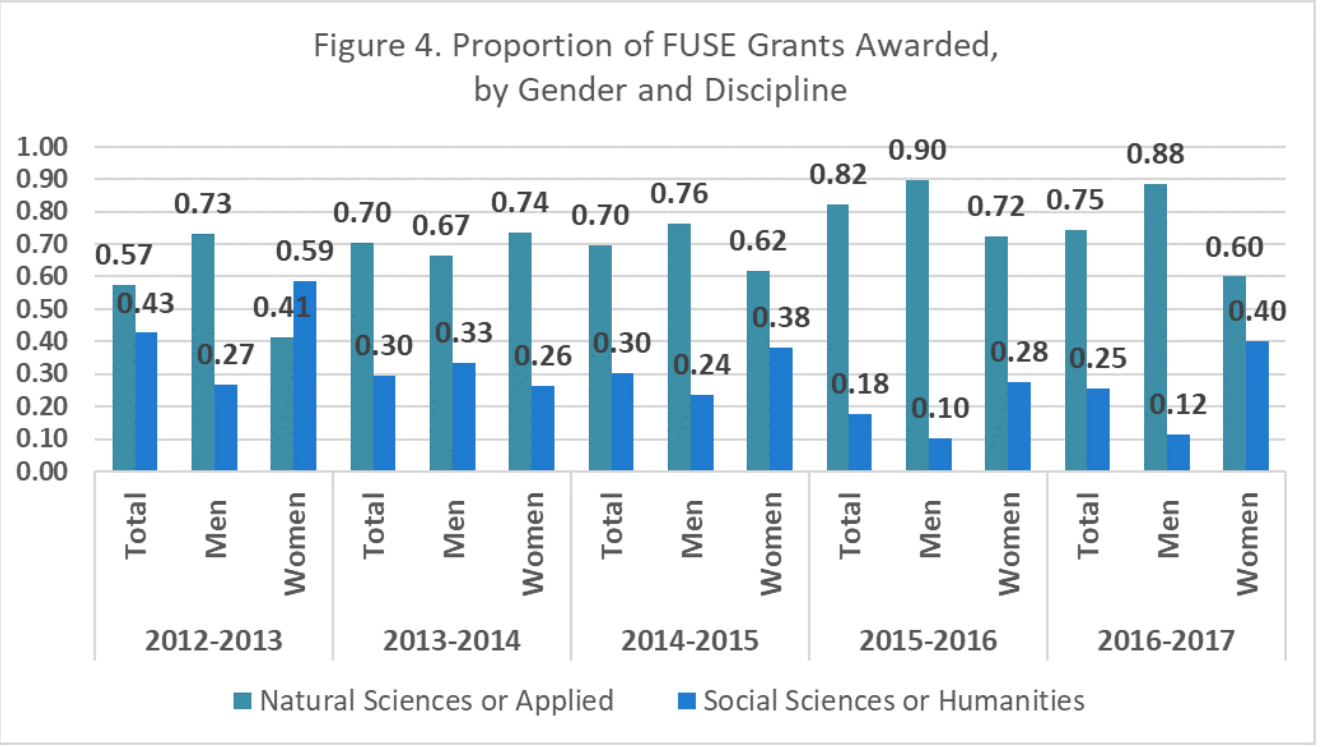


Figure 3. FUSE Grants Awarded, by Discipline and Year





When we analyzed how gender and discipline intersected over time among FUSE grant recipients, we noticed a striking pattern (see Figure 4). In 2012-2013 there were slightly more natural science or applied FUSE grants than social science or humanities. However, almost three-fourths of the men awarded FUSE grants were pursing natural science or applied projects while a little more than a quarter of men were engaged in social science or humanities projects.

Among women, the opposite pattern emerged, with roughly 60% of women having FUSE projects in the social science/humanities while 41% pursued a natural science or applied FUSE grant. In subsequent years, women continue to engage in more social science or humanities projects than men, and men continue to engage in more natural science or applied projects than women.

However, our data suggests that the gender gap among natural science or applied projects is persistent and may be widening. Over the last several years, the percentage of men pursuing these forms of FUSE projects has increased compared to women:

2012-2013, 73% of men versus 43% of women
2013-2014 70% of men versus 67% of women
2014-2015, 76% of men versus 62% of women
2015-2016 90% of men versus 72% of women
2016-2017 88% of men versus 60% of women

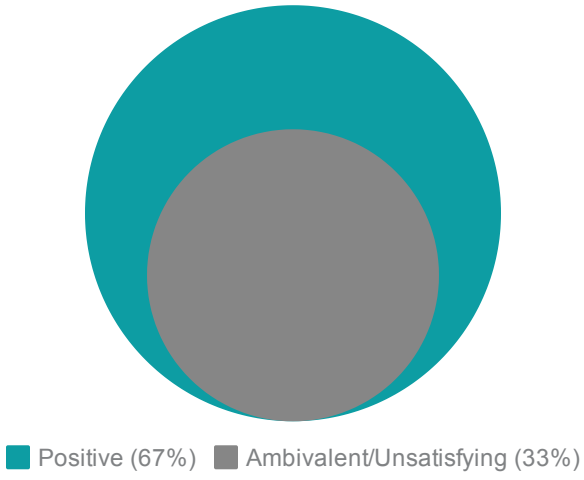
Given that there is a trend toward a greater number of natural science or applied FUSE grants rather than social science or humanities (see Figure 3), this means that women undergraduates may be less likely than men to have funded FUSE grants going forward.

The gender gap among natural science or applied FUSE projects is persistent.

Working with Faculty Mentors

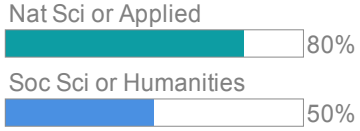
While institutional data can tell us trends in FUSE grants, it does not shed light on whether or not students felt supported during their project. Interviews with 19 students who received FUSE grants in fall 2013 and spring 2014 revealed that most had positive experiences with their mentors. Of the students who answered the question, only six were ambivalent or unsatisfied in some way about their relationship with their mentor.

Figure 5. Perceptions of Faculty Mentor-Student Relationship



Out of the 18 students who answered the mentor relationship question, those with FUSE projects in the natural or applied sciences tended to have more positive mentor-student relationships than those in the social sciences or humanities.

Percentage of Interviewees Reporting a Positive Faculty Mentor-Student Relationship



When the Mentor Relationship Goes Well

For those that thought they had a good relationship, they consistently mentioned having a mentor that cared about them, was "helpful" or "supportive." In the words of one respondent, their mentor made them feel "like you actually matter."

Students appreciated mentors who provided guidance and did not micro-manage the research. One student summed this up well by saying "like a true mentor, he didn't hold my hand through it."

Often caring and finding a balance were intertwined in their comments. As one student told us, "[My mentor] is very driven and very involved. He cares about our success individually and the success of the lab itself. He is accepting and understanding that we're undergraduates and not graduate students. His expectations of us are realistic but also ambitious to the extent that I think it drives us to work for him. We don't want to disappoint him in a way. He's been a really great mentor. The exact combination kind of... on top of me but also gives me this intellectual freedom that I feel like I need."

Likewise, another student commented "She was very supporting, and she gave me the idea but she was mostly kind of like the steerer. Like if I had an idea she was like 'do it. I'm not here to tell you how to do your project. I'm here to give you ideas and help you work through problems that you come across.'"

"Like a true mentor, he didn't hold my hand through it."

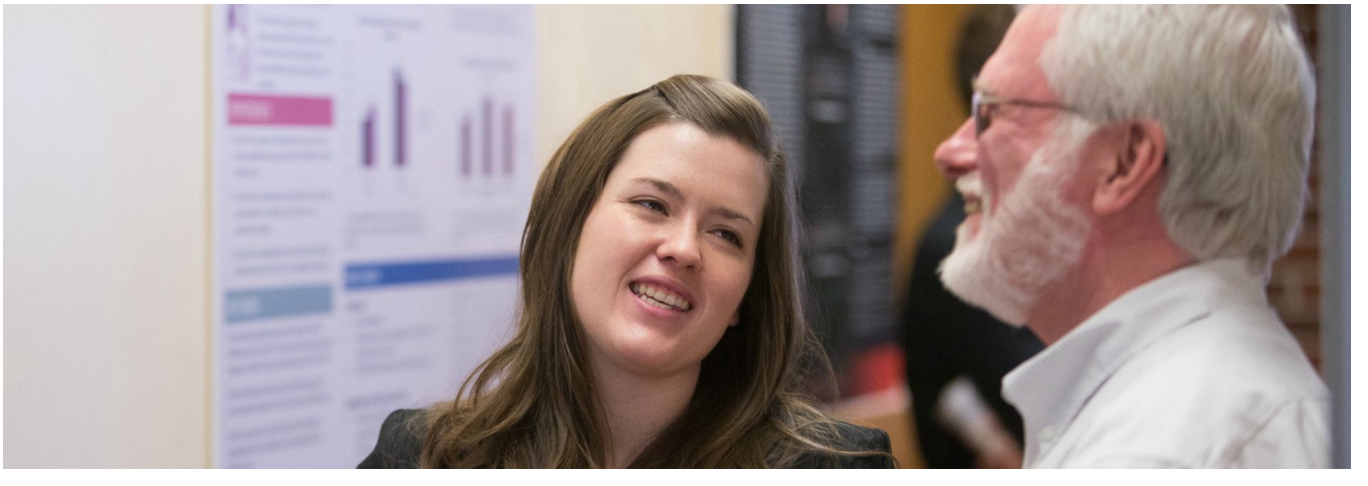
Times When the Mentor Relationship Could have Gone Better

For respondents who were ambivalent or had a less positive mentor relationship, usually they either felt neglected or that the balance in the relationship was not quite right.

One respondent was unusual in that his mentor was also his boss, and he thought this complicated their relationship. He was worried about disappointing her and it spilling over and affecting his job. As he explained "I'm horribly afraid of failure and getting yelled at. That's my biggest fear. So, it's all me. I will admit that. It's not her. She's just doing her job keeping up with me and it's me worrying about the worst possible outcome and she'd be like "you're not getting anything done. Get out of here (laughs).'"

For the rest of the six respondents though, something was lacking but they did not lay the blame squarely on their mentor. A student told us "I wanted more help than I was receiving. But, all in all at the end he kind of came through and I can't really be too upset with him because I think the process was new for both of us." Another explained that their mentor offered "mostly moral contributions" but "that was the kind of support that worked for me, and then I felt like I didn't check-in with him enough because there were a lot of times that I did struggle but then I never went to ask for like counsel or whatever."

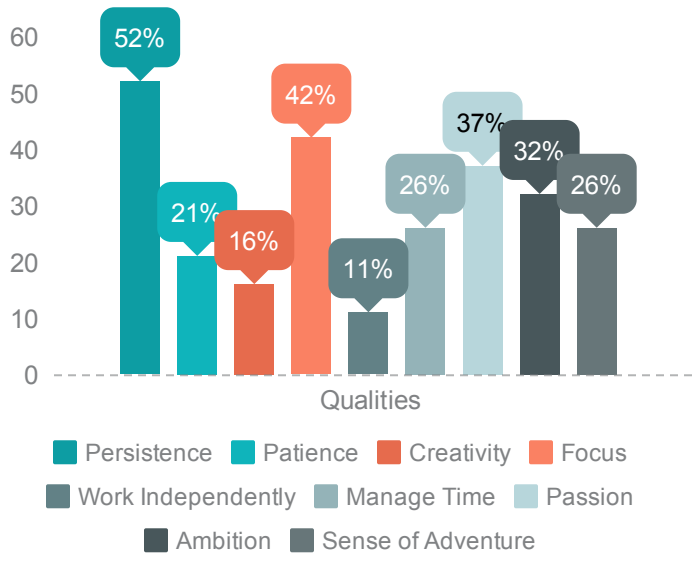
Students were worried about disappointing their mentor, but shared the blame for the relationship not being as productive as possible



What Qualities Does a Researcher Need to Possess?

When we asked past FUSE grant recipients "what three qualities do you need to be a researcher?" students answers tended to focus on personality traits and work habits: only one person said knowledge was important. While there were a few ways that men and women's answers differed, there were no striking differences by discipline.

Figure 6. Researcher Qualities



Most common trait mentioned was persistence & determination

Theme 1: Sticking with the Project

Students often mentioned the importance of being persistent or having determination. Women in particular, were more likely to say that carrying a research or creative project through to completion was much harder than they imagined it to be (62% of women versus 33% of men). As one student said "...because the process can be very defeating" and another added "Once you hit a wall, you can't just say 'oh, well, eh.' You have to have the willingness to get over the wall that you just hit. 'Cause it happens a lot."

Relatedly, patience emerged four times in interviews, and three students said that it was vital to be creative and problem-solve.

Figure 7. Persistence, Patience, and Creativity as Needed Researcher Qualities, by Gender

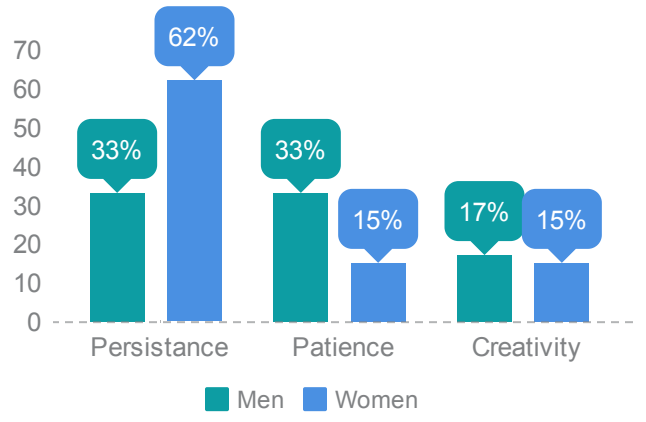
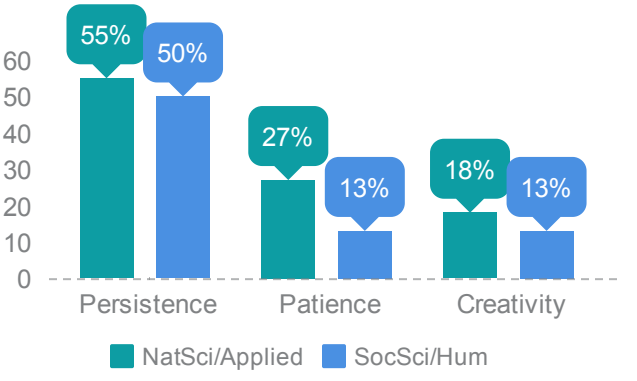


Figure 8. Persistence, Patience, and Creativity as Needed Researcher Qualities, by Discipline



Theme 2: Work Habits

The second most common theme mentioned was the necessity of being committed, focused, or having a good work ethic. Eight students mentioned this as an important quality.

One FUSE grant recipient told us how he struggled with this during his project. "Be goal-oriented. Know where you want to head, what's your final... What are you looking for? It was kind of an issue with mine because I knew what I wanted to do but I didn't really... I didn't really know exactly where that was. I knew the direction but not the place kind of thing. I think you need to have an end goal or short term goals throughout."

Closely-related to this, was the ability to work independently, with two students mentioning its importance. Managing time well and being organized were discussed by 5 students.

Focus & commitment were a close second

Theme 3: Keeping the Excitement Going & Maintaining a Sense of Wonder

The third theme that emerged was being interested or passionate about the topic, and then maintaining a sense of wonder especially in the face of obstacles. Having a strong interest in the topic was a critical first step to getting started, but it was necessary to hold onto it throughout the research process. As one student explained, "If you don't really care then you're not going get anything off the ground." Another told us that without passion, the research or creative activity "is just going to become tedious and you're just going to give up." Passion also mattered when reaching an audience though, as one student explained: "You have to have the passion to tell the story. 'Cause if you have passion, you'll at least get something across."

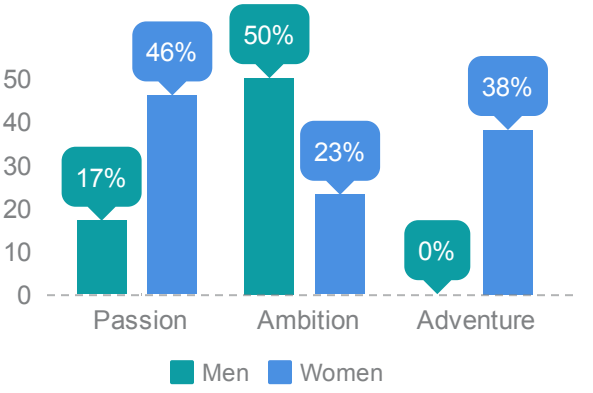
While interest or passion was mentioned by 7 students (mostly women), having ambition or drive was mentioned by 6 respondents. As one student told us "You have to have the will to better yourself. Cuz if you don't want to learn anything there's no point in doing it."

Closely related to interest was the importance of curiosity or the sense of adventure and fun that comes from doing research. This concept emerged 5 times, and only among women. As one told us "Don't let your curiosity die. I know of many people who walked into something passionate but because of other people or because of circumstances, lost sight of what they fell in love with at the beginning. So, keep challenging yourself. You will never know everything. And finding those things that intrigue and keep at them. Keep pursuing them." Another explained "I think too often for me. I like to control things. I like to be in control of the situation. But, I kinda let this project lead me. You know, pave the way for me and it's kinda led me down some interesting pathways and connected me with some really interesting people. So, yeah, definitely a sense of adventure... and people are like 'Oh, my gosh! You're such a nerd.' You know, 'who does that with research?' And I'm like 'well, you never know."

Interestingly, four out of five of the students came to these realizations on their own. Only one student was explicitly coached on the importance of curiosity by their mentor: "like [my mentor] always taught me is that, you know, 80% of the time things aren't going to work out. But if that 20% of the time is rewarding enough for you, and that keeps you going, then that's what lets you know that you can be a researcher. Like, most of it's really shitty and you're going to fail all the time, but if every once in a while you do something right? You find something and that makes it all worth it? That's the most important character aspect you need to have."

"If you don't want to learn anything, there's no point in doing it."

Figure 9. Passion, Ambition, and Adventure as Needed Researcher Qualities, by Gender



Maintaining a sense of adventure was especially important to women

Advice to Others

When we asked our interviewees "what advice would you give other students who are thinking about participating in FUSE?" a small handful mentioned the importance of selecting a good mentor, finding a balance between research, school, and other interests, picking an area of interest, and not getting discouraged along the way. Women were more likely to mention that balance was critical, while men were more likely to advise pursuing an area of interest.

Figure 10. Women's Advice to Others

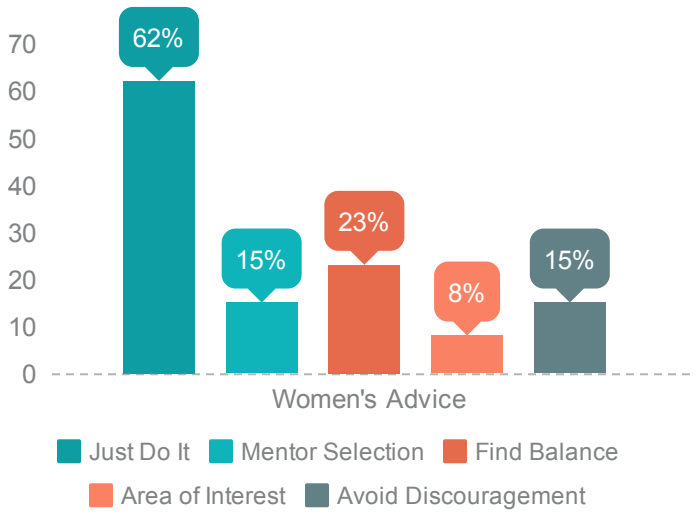
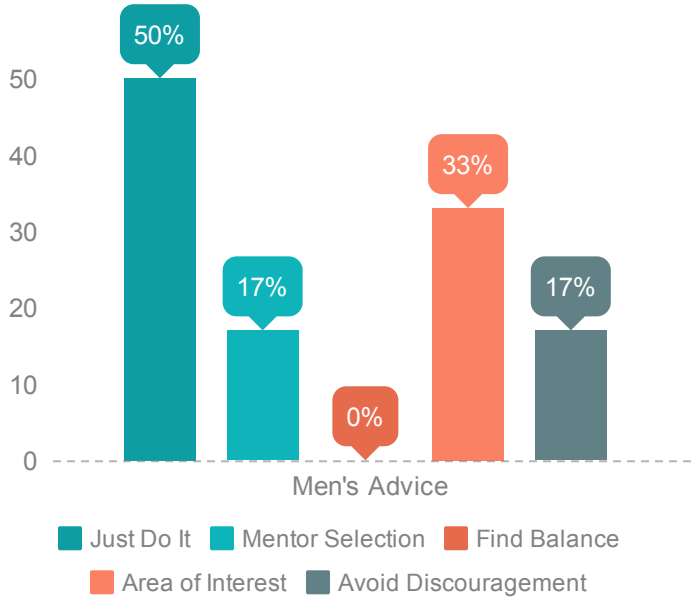


Figure 11. Men's Advice to Others



By far the advice our interviewees most frequently had for other students was to "just do it,"especially if they were in a natural science or applied discipline. Over half said that while their research experience may not have been easy, they were nevertheless strongly supportive and eager for others to try it themselves. As one told us, "I would definitely encourage people to try research because I think it is one of those things that you really don't know if you'll like it or not, until you try it."

Although FUSE projects challenged undergraduate students in multiple ways, recipients still encouraged others to pursue a FUSE grant

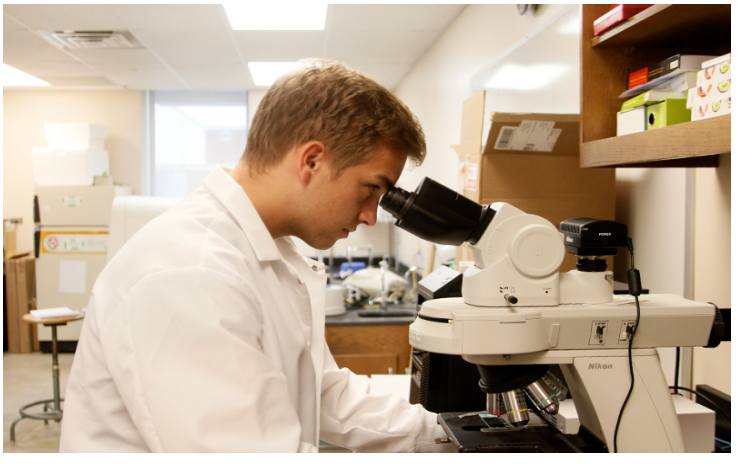
Student: I would tell them that they should definitely do it if they're interested in doing research. What advice I would give them is 'don't fall behind with other things.' I guess that's with anything in life. Don't forget you have other things to do too.

Interviewer: Would you do it again?

Student: I would do it again. Oh, advice I would give them. I would say don't get discouraged.'

Interviewer: With the process?

Student: With any of it. It's really... It really was an eye-opener cause everything doesn't work out the way that it should (laughs).



What is the Value of Research (for You as an Individual)?

When we asked students "what is the value of doing research, both for yourself as an individual and for society as a whole?" their answers revealed several patterns.

Cultivating Capabilities & Self-Awareness

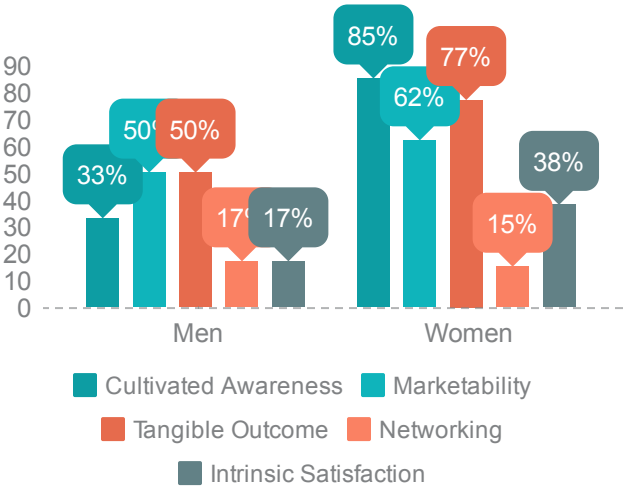
By far, the majority of our respondents (thirteen out of nineteen) said that research was important to them because it cultivated a greater awareness of their own capabilities and interests, and changed their perspective. Women were more likely to have this theme than were men.

As one woman told us "We research outside our comfort zones and we learn about other people. Therefore we can not only touch them but touch ourselves. In a sense, I learned so much about myself through this whole process... I didn't realize that I had that type of belief, or I had that type of prejudice or that I had that stereotype or what have you. I just learned a lot about myself. So I feel like I'm becoming a more and more well-rounded individual." Another of the thirteen interviewees who shared this theme discussed how research made others take him more seriously: "there's a kind of power in knowing how to do that [research]. Because people take research more seriously than one individual's voice or sometimes many individual's voices."

Overall though, our interviewees thought that research had changed them in a positive way. As one student said "I think for myself, I really just want to be like the type of person who is always learning, you know? I think it's a cool idea to be like a producer of knowledge instead of just like a consumer of knowledge."

Women were more likely to say that FUSE increased their self-awareness

Figure 12. Value of Research for the Student, by Gender



Research Pays off: Marketability

Many students that we interviewed thought their research experience and the skills they sharpened made their curriculum vitae or resume more compelling to employers or graduate schools. Eleven students said echoed something along the same lines as one woman's comment: "I have all these things that I've accomplished. Hopefully that will set me apart from some other people."

For one respondent, this hope had turned into a reality. Having already graduated, he was now working with a community-based research team: "It's important because it's a skill that I've taken with me and that I use in my community. Not necessarily through academic research but community based research. And to be able to have that tool is really helpful."

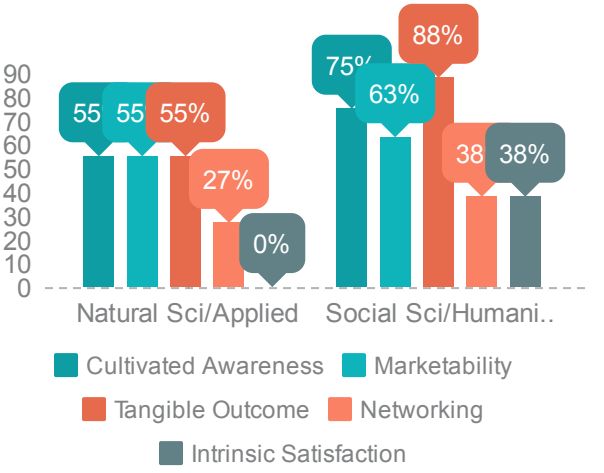
"It's a skill that I've taken with me and that I use in my community."

Tangible Outcomes & Networking

While all students awarded a FUSE are required to create a poster of their project and present it at at the UNO Research & Creative Activity fair, many of the students we talked with went beyond that and had other outcomes as a result of their research project—especially women and those in the social sciences or humanities. Some were hoping a publication would emerge, others wrote a computer program or were working on turning their project into a book. A few had presented their research at conferences out of state, had creative projects that were in use by the community, or had a public performance that showcased their FUSE project.

Additionally, three interviewees (all in the social sciences or humanities) thought that participating in FUSE had resulted in greater exposure and contacts they normally would not have created with other scholars.

Figure 13. Value of Research for the Student, by Discipline



Intrinsic Satisfaction & Giving Back

Hard tangibles aside, feeling like they were contributing to something greater than themselves offered intrinsic satisfaction to six respondents (the vast majority of whom were women). As one woman told us "There's so much satisfaction in research, personally. Because you feel like you're doing something that contributes to health and knowledge worldwide. You're contributing something to your society. You're giving back. I've always felt that was really important.... I just think it's the right thing to do. As a global citizen, people should give back to their society. And I think science is the way I know how to do that. And it's the way I feel right doing it."

FUSE continues to "pay off" long after the grant ends

"As a global citizen, people should give back to their society. And I think science is the way I know how to do that."

What is the Value of Research (for Society)?

When discussing the value of research for society, our interviewee's responses coalesced into two patterns. Most respondents mentioned that research improved lives or helped the planet in some way, or discussed the importance of advancing knowledge, whether academically or educating the broader public's understanding of a topic.

Figure 14. Value of Research for Society, by Gender

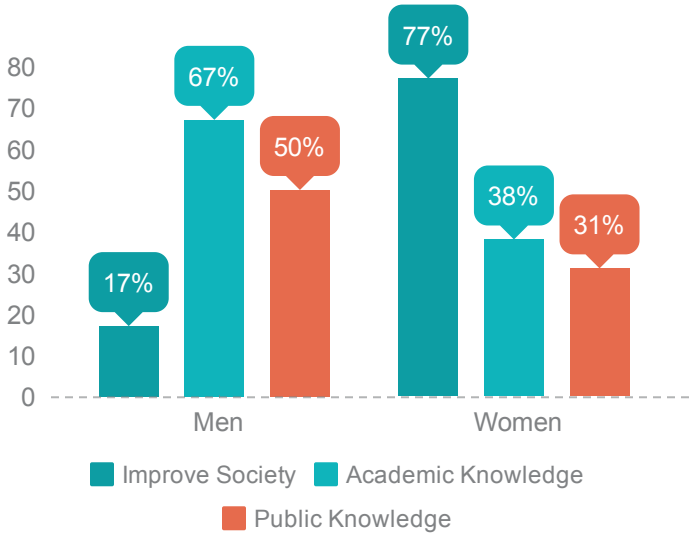
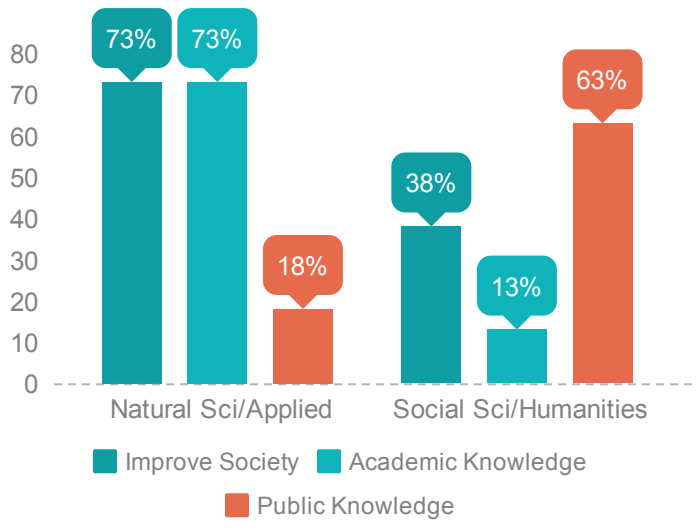


Figure 15. Value of Research for Society, by Discipline



Advancing Academic Knowledge

Nine interviewees responded that research furthered our understanding of an area in a basic "knowledge for knowledge's sake"way. Advancing academic knowledge was mentioned more often by men and those in the natural or applied sciences.

> "I think that research is really important because it's like us keeping track of like a historical record so like things don't have to done twice or so many times. Because science is the accumulation of knowledge that builds upon knowledge that's already accumulated. So, this is just part of that snowball effect of keeping track of things, so that if we have questions about it we know how to do it."

Advancing the Public's Knowledge

Research Educates, Unifies & Strengthens Bonds

Several interviewees told us that research was not just about furthering knowledge among academics: it led to a better informed society. As one woman told us "I think it's important to spread knowledge about science. In my opinion, the general population is either ignorant or just entirely unaware of what science is, it's advantages for society, [and] what it brings to a society in terms of research, both on a macro and micro perspective....I don't think people understand how important it is to research and learn more about humans and the physical world." She then took her response one step further, and mentioned that research had the power to unify: "It makes us a more intellectually thought-driven community. It allows for global sharing, which forces us into this inclusive environment of other people. It's not us versus them. Because science can be spread and shared globally, so can community and ideas."

Interviewees in the social sciences and humanities tended to mention advantages to public knowledge more than those in the natural or applied sciences.

Solving Problems & Strengthening Society

Over half of our respondents believed that research had the power to solve problems and improve lives, and they were excited about being a part of that endeavor. As one interviewee told us, "[Research] creates a more powerful society."

The gender and discipline effects were particularly striking: 77% of women versus 17% of men mentioned improvements to society resulting from research or creative activity, as did 73% of natural or applied sciences versus 38% of social sciences or humanities.

Women, and those in the Natural Sciences or Applied Sciences Stressed Societal Improvement Most

"Scientific advances are always good, even if it's just proof of concept like I did. No matter how small of an advancement, it's still an advancement and a better forwarding of humanity."

Conclusions

In this report we document patterns in UNO FUSE grants by gender and discipline between 2012 and 2017, and use interview data from 19 funded awardees to discuss patterns in their experiences conducting their research or creative activity project. While our data does not allow us to generalize to all undergraduates at UNO, it nevertheless provides a glimpse into who is successful at pursuing extra-curricular research and creative activity at UNO, and offers guidance for increasing and improving student engagement outside of the classroom. Our findings lead us to the following recommendations:

Insights for Students and Faculty Mentors

Learning how to write a successfully funded grant as an undergraduate student, and work closely with a mentor to carry out a research or creative project can be advantageous for several reasons. FUSE grants can be listed on a resume or C.V. and "signals" to prospective employers and graduate schools that this student went above and beyond the requirements for graduation. In addition, FUSE awardees likely possess desirable personality traits (such as creativity, persistence, and ambition) and soft and hard skills (time management, public speaking, critical thinking, project-specific knowledge, and ability to work with others). FUSE projects can also be advantageous for networking purposes, connecting students to scholars pursuing similar questions, as well as community members and future employers. Moreover, completing a project can further student's self-development and sense of self-efficacy.

When they are finished with their FUSE project, mentors and students could work together and reflect on the skills the student has learned as a result of their creative activity or research, and help translate these ideas into job or school-related materials (such as CVs, resumes, or talking points for a graduate school or job interview).

While most of the students we interviewed thought their faculty-student mentor relationship went well, our interviews revealed that there is some room for improvement. It may be advantageous to counsel students that research and creative activity means embarking on a journey that is inherently ambiguous, uncertain, and yields unexpected twists and turns: normalize these emotions, and the discuss the creativity that is involved in FUSE projects [vii].

Insights for UNO Administrators

At the university level, supporting undergraduate research and creative activity through grants and mentoring is a window into our university values and priorities. Having students involved in FUSE projects supports three out of four of our core goals: student-centered, academic excellence, and community engagement. Additionally, FUSE projects can be used to dispel claims in the popular press that colleges and universities are not preparing students for paid employment [viii]. If marketed well, FUSE may also aid our efforts to increase enrollment, boost student retention, as well as build our image within higher education and our surrounding community.

Our findings also suggest that UNO may not be impervious to gender and STEM-related trends that are present within our wider society [ix]. We urge the university to monitor FUSE, and to be vigilant in ensuring that all students are equally encouraged to participate in research and creative activity -- whether it be social science, natural science, fine arts, or humanities. Although there is a tendency to value natural and applied sciences over social sciences, humanities, or fine arts (x], they are all necessary in our society.

Appendix: Methodology & Works Cited

To understand who is pursing extra-curricular undergraduate research at UNO and their experiences conducting a study or creative activity, we limited our population to students who were successfully awarded a UNO Fund for Scholarly Excellence (FUSE) award between 2012-2017. Using a mixed methods approach, we gathered publicly-available institutional data that listed FUSE awardees, and we interviewed a sub-sample of these undergraduate grant recipients (IRB#589-14EX) to better understand their research or creative activity experiences.

Institutional Data, Coding & Analysis

Our institutional data contained first and last name, as well as college, department, faculty mentor, amount of award, and the project title. We coded FUSE awardees by gender and by whether their project was a natural/applied science or social science/humanities.In most cases, gender was easily determined by first name (e.g. "Michael" was coded as a man, but "Kimberly" was coded as a woman). However, out of the 374 awardees there were 71 cases where the first name was gender neutral or could not be determined. We then conducted internet searches (google, facebook, and linkedin) with their first and last name and "UNO." We looked for entries that contained gender pronouns or other identifying information (such as participation in a men's soccer team) to determine whether to code them as women or men. For three cases, we had to take the additional step of emailing their faculty mentors and asking how their FUSE student self-identified because our internet search was unsuccessful. To code whether the research or creative activity was a social science or humanities project or a natural science or applied project (such as engineering or computer science), we coded the project title. In the few cases where the project title was ambiguous or vague, we examined the department and the typical kind of research that the faculty mentor performed to determine discipline placement. We coded neuroscience as a natural science.

We performed frequency counts of gender and discipline for the institutional data, and ran simple descriptive analyses.

Interview Data, Coding & Analysis

During fall 2014, students enrolled in SOC 4410/8416 (Advanced Qualitative Methods) interviewed a subsample of present and former FUSE awardees (IRB# 589-14-EX). Using a mixture of disproportionate stratified and quota sampling, we drew our respondents from the publicly available list of FUSE recipients in fall 2013 and spring 2014, taking care to obtain roughly equal numbers of natural science and social science/humanities research or creative activity projects. After sending two waves of recruitment emails, nineteen students agreed to participate. We did not compensate respondents for their time. Through semi-structured interviews, respondents were asked about their FUSE experiences (the application process as well as how their FUSE project unfolded as they carried it out), reflections on what qualities a researcher needed to succeed, the value of research for themselves as well as society, as well as a few demographic questions (age, college major). Our respondents ranged in age from 20 to 45, with an average age of 25. Most interviewees were in their early 20s. Thirteen women and six men participated. Eight of the 19 respondents had a social science or humanities project, and 11 had FUSE project in applied or natural sciences.

All interviews were transcribed verbatim and coded in Atlas.ti using a grounded theory approach.

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