SCHREYER HONORS COLLEGE

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BRIDGING THE GAP BETWEEN SCIENTIFIC RESEARCHERS AND THE UNIVERSITY COMMUNITY THROUGH STUDENT JOURNALISM

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ABSTRACT

Perhaps just as important as scientific research itself, the communication of that science to the public is essential to public engagement with the research and the scientific process. Without it, many might never know or understand the impact that the research has on them, understand the scientific process, or value its contributions to human society. Previous studies examined science communication, particularly through journalism. However, less is known about student media communication of science at research universities. This thesis explored this issue by speaking with student journalists, principal investigators and the student community at a research institution, and by using a content analysis of the student media outlets' past science coverage. Some of the findings included that principal investigators say they prefer to use other institutional strategic channels for science communication instead of student media outlets; that student journalists should push their science coverage on social media to bring it more attention; and that the student audience prefers a human-interest angle—whether that be through narrative storytelling of the people behind the research or by clearly demonstrating the research's impact on general people—to make science stories more interesting and engaging.

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Chapter 1

Introduction

At a large research university, opportunities to learn about scientific discovery are endless. Countless numbers of students partake in these scientific research endeavors each year as paid research assistants, by working in research labs as students, or as students in science courses and programs. However, these areas can be less visible for others around the university and community, even though much of the work is impactful. As a result, the work that is being done in university research laboratories may not always be as covered by journalists. And because of this, not only much of the research, but also many of the people may be unknown to the rest of the university. There are a variety of reasons why this could be—maybe journalists don't cover the research laboratories as much, maybe the principal investigators of the laboratories aren't seeking out publicity, or maybe the student public at universities is just not interested in hearing about the work being done in the scientific research community.

Although science communication is a growing area for research, there hasn't been research done on the communication of science at the university level—especially through student journalism. Student media outlets can be the key providers for news coverage about university activities for student populations. So how the student journalists provide coverage of the scientific community to the rest of the public is important to understand.

This study aims to provide a deeper understanding of the perceptions of student news consumers, student journalists and researchers at universities regarding science communication. It does this by looking at the issue from the views of student and professional journalists,

principal investigators and the student public. By bridging the gap in science communication at universities through student journalism, more of the important work being done by researchers in laboratories can be brought to the public eye.

Chapter 2

Literature Review

News Values, Newsworthiness and News Formats

When it comes to deciding what makes the news, there are many factors to consider. News values such as timeliness, proximity, impact, prominence, oddity, relevance and conflict often play a significant role in what is covered and published. However, audience preferences also influence content, and the audience may not always be interested in the stories that journalists value the most. A study by Singer (2011) that focused on local news considered 'traffic drivers' as the stories that garnered the most audience attention in terms of views, while stories that were 'sources of pride' as the stories that journalists felt the most proud of. Out of the 432 news items that were analyzed, almost 60 percent of them were 'traffic drivers.' Only about 30 percent of the stories were both 'traffic drivers' and 'sources of pride.' While more of the 'traffic drivers' were hard news stories, more of the 'sources of pride' were soft news stories. Additionally, the study found that the stories that contained the most overlap between being a 'source of pride" and a 'traffic driver,' were sports stories. So sports were the biggest topic in the news coverage of the Johnston Press (Singer, 2011). According to a 2016 study using the five largest newspapers in the Netherlands, the topics found within the most-viewed stories received more follow-up coverage from journalists in the future (Welbers et al., 2016).

How a story is covered can also have implications for audience interest. One key distinction in news writing involves hard news and soft news. The differences between the two formats has been explained by (Reinemann et al., 2011, p. 233) as:

> The more a news item is politically relevant, the more it reports in a thematic way, focuses on the societal consequences of events, is impersonal and unemotional in style, the more it can be regarded as hard news. The more a news item is not politically relevant, the more it reports in an episodic way, focuses on individual consequences of events, is personal and emotional in style, the more it can be regarded as soft news.

A study by Patterson (2011**)** showed that the news is becoming softer. From 5,331 different news items, he discovered more news items without a public policy component, more sensationalism, more human interest, more human-interest news, and more self-references and less use of collectives. Another study that involved stories published on the Arizona local news subscription website, azcentral.com, examined the effect of certain news values on audience views. The news values that were used in the study included proximity, conflict, human interest, tragedy/disaster, magnitude, timeliness and prominence. Of those news values, the most-viewed stories were seen to have proximity (75.9 percent) or conflict (31 percent). Human interest was present in 18.5 percent of the stories analyzed (Schaudt & Carpenter, 2009). The results of the study demonstrated that soft news stories were preferred among the audience more than hard news stories. Sixty-three percent of the most-viewed stories were soft news compared to 37 percent being classified as hard news. In addition, the study did not support the thought that the audience likes reading shorter stories on the Internet. Instead, the trend that the study observed was that the more news values that were present, or the more angles that were covered in the story, the more the stories were viewed. For instance, while there was an average of 66 page views per story with one news value, there was an average of 1,847 page views per story with

four news values (Schaudt & Carpenter, 2009). And as this study displayed the popularity of soft news, or more feature-type articles, another study in the *International Journal of Internet Science* demonstrated the importance of such articles. This study concluded that for experienced Internet users, online features really serve their benefits when the content is difficult to grasp (Opgenhaffen, 2011).

Digital Technologies and News Consumption

Digital technologies have drastically impacted journalism industries. In a 2017 survey done by the Pew Research Center, 43 percent of Americans responded they often get their news online (Funk et al., 2017). Although this number is slightly lower when compared to the number of people often using television to get news—50 percent—the gap between the two different media is quickly narrowing. Compared to 2016's 19 percent gap, the gap between online and television news consumption had shrunk to 7 percent in 2017. This signifies the growing importance that online news sites and social media have in terms of news consumption (Funk et al., 2017).

Cell phones are also increasingly popular news delivery devices. While the 31 percent of people in the 2017 study who say they got their news often on computers remains stable from previous years, the effects of mobile devices continues to increase. In 2013, only 21 percent of U.S. adults often got news on their mobile devices. But in 2017, that number had jumped to 45 percent. Only 18 percent of people said they often get news from print newspapers (Funk et al., 2017).

Social media has also impacted how Americans receive their news. According to Funk et al. (2017), two-thirds of Americans get some news from social media every day. In fact, the online news audience was about just as likely to get their news by going through social media as they were going directly to the online news site. The percentages of online news consumers getting news through social media and directly through online sites were 35 and 36 percent respectively (Funk et al., 2017).

Though the percentage of people who consume some news through social media has only marginally increased from 67 percent to 68 percent according to a 2018 Pew Research study, the impact of social media in current society cannot be understated. According to the Pew study, 21 percent of people see convenience as the primary reason for their use of social media. In addition to this, 8 percent of social media users say what they like most about the platforms is the ability to socially interact with others, while 7 percent of users say they like it mostly because of its speed (Shearer & Matsa, 2018). The top two criticisms of social media were inaccuracy and political bias. Thirty-one percent of people most disliked inaccuracy while 11 percent said that there was too much bias on the platforms. With these drawbacks, however, users still see the important benefits in their consumption of social media. More than one-third of social media consumers say that it has a positive effect on their understanding of news or current events (Shearer & Matsa, 2018).

The numbers that were seen in the 2017 Pew Research study regarding the general U.S. population's consumption of online news are even higher when looking solely at college-aged people. In that same study, the 18-29 age group was seen to have 52 percent of people often get their news online compared to the much lower 23 percent of people in the group who got their news on television (Funk et al., 2017). These numbers are in stark contrast to those seen in the

general population. The percentage of consumers who got their news often on television was 7 percent higher than the percentage of consumers who got their news often online when all age groups were considered. Therefore, the popularity of online news consumption seen in the majority of college-aged citizens cannot be understated. And both the rise in the reliance on smartphones and in the use of social media can be linked to that considerable difference (Funk et al., 2017). As this generation ages, this trend will only become more and more visible.

The percentage of people who use social media only increases when also honing in on the age group that contains college kids—the 18-49 age group. Within that age group, 78 percent of people are social media consumers, and those without a bachelor's degree are more likely to use social media in their lives. So college-aged kids are the primary users of the social media platforms (Shearer & Matsa, 2018).

In terms of student social media use, the two most pertinent platforms for students consuming information may be Facebook and Twitter: 34 percent of Facebook users and 35 percent of Twitter users are college students (Shearer & Matsa, 2018). Specifically, Twitter was found to have a special relationship with student users as compared to non-student users. One study found that student Twitter users distinctly use the platform as a source of information for current events. With the links provided in tweets, students rely on Twitter to get a lot of their information from stories online (Wertalik, 2017).

News Consumers' Interest in Science Reporting

Although the majority of Americans are not active science news consumers, most Americans do express a curiosity in science news. While only 25 percent of Americans say that

they are very interested in science news, 71 percent of Americans have at least some interest in science news (Funk et al., 2017). This level of interest in seeing science trumps that for other major categories such as finance and business, sports, and entertainment. Those interest levels are at 60, 47 and 47 percent respectively (Funk et al., 2017).

In particular, there are certain science stories that garner higher interest from science news media consumers. According to Funk et al.'s (2017) study, the health/medicine category is the science discipline that seems to garner the most interest among U.S. adults as 28 percent of U.S. adults say they are most interested in it, while 70 percent say they are interested in it. Food/nutrition and technology also are highly interesting as 17 percent of U.S. adults report each of these categories as their most interesting science topic. The two science topics that generate the least interest among U.S. adults are space/astronomy and human/animal evolution (Funk et al., 2017). Chemistry was also found to have a negative interesting rating because of its difficulty and perception of being boring (Badenschier & Wormer, 2011). On the production side, health/medicine dominates science coverage worldwide (Bucchi & Mazzolini, 2003; Artz & Wormer, 2011). In German newspapers, medicine was the subject of 28 percent to 29 percent and biology was the subject of 13 percent to 14 percent of science articles. This is because certain scientific fields contain more news values than others (Elmer at al., 2008). An example is how biomedical issues usually have a wider range and more relevance to many readers (Artz & Wormer, 2011).

The researchers also found that only 17 percent of U.S. adults actively seek out science news. This means that most consumers get their science news by chance. To be exact, 68 percent of American adults get their science news because they "happen to come across it" (Funk et al., 2017, p. 16). But for those who do follow science news, the major reason is because of general

curiosity in the science—81 percent of people say it's a reason and 39 percent of people say it's a major reason why they consume science news. Other reasons also include because it helps them make decisions in their lives and since they enjoy socially interacting with others regarding science (Funk et al., 2017).

One reason why U.S. adults don't consume science news as much may be because the outlets they monitor don't produce much science content. This is in contrast to the 52 percent of American adults who enjoy hearing about science through the news more than other topics (Funk et al., 2017). And an important note to add is that one study found that when using the news media to introduce a science topic, it increased engagement in discussion regarding the science from the public. The study specifically found that when newspapers covered a stem cell and cloning debate, there was a positive relationship in terms of the willingness of the public audience to attend a deliberation discussing the stem cell debate (Goidel & Nisbet, 2006).

So some research has found when the public interacts with science news, positive effects can be seen, such as learning. As noted with other general news trends, almost 60 percent of Americans said the Internet is where they go to learn more about science news (Science and Technology, 2018). One study found that using online-only sources led to a higher understanding of science (Su et al., 2015), while another found that traditional science media often tailor their science coverage to more educated people (Brossard & Scheufele, 2013; Wilkins, 2008). In comparison, other research found online media platforms bring coverage that is geared toward a public with varying science educational levels (Bimber, 2003; Walejko & Ksiazek, 2010).

The effects of social media can be seen too as 44 percent of social media users at least sometimes get news there that wouldn't be found elsewhere. Along with this, 33 percent of American adults say social media is an important source for science news. And despite the

majority of American adults generally distrusting the science they see on social media, over half of its users still click on the links within the social media science posts. The top two science-related subjects most often seen on the social platforms are either strange scientific research findings or new scientific discoveries (Funk et al., 2017).

Science Journalism

Science reporting is one of the few ways that people can learn about important scientific events that may affect their lives. While serving this purpose, science journalism's ability to bring a more general angle to the science and therefore allow people to relate to it, gives the audience the opportunity to form its own opinion on the important science issues being discussed (Treise & Weigold, 2002).

Historically, specialized beat reporters on print newspaper staffs provided science coverage. But with the increased digital presence and newsroom transformation, print news teams have had to reduce employee numbers and consolidate or eliminate beats. In 1989, 95 newspapers had weekly science sections; however by 2005, that number had been reduced to 34 newspapers, and in 2013, that number stood at only 19 newspapers (Scheufele, 2013). In 2008, CNN cut all of the members of its science, technology and environmental news staff (Allan, 2011). Additionally, The New York Times moved seven reporters and two editors from its environmental coverage team to other sections within the newspaper in 2013. And although there has been a renewed emphasis on science coverage as the New York Times now has a climate desk, and science, environmental and health beats, not all newspapers have the resources to provide this level of coverage.

But journalists play a crucial role in connecting the public with scientists and scientific research. They provide essential functions such as acting as “conduits and explainers,” “curators of information,” “civic educators,” “public intellectuals,” “agenda-setters,” “watchdogs” and “conveners/connectors” (Fahy & Nisbet, 2011, p. 786-789).

However, the digital age of journalism is changing how journalists cover science. Some have expressed concern about how easy it is to write and publish information at any time (Allan, 2011). There is also a worry that the news could fall into the trap of sensationalism or hyping science news, while also starting to practice ‘churnalism,’ where the sole goal of writing stories is to write more stories than anybody else as opposed to only writing about the content that the public needs to know about (Allan, 2011).

Cristine Russell, a science, environmental and health writer, also sees digital platforms as potential concerns for confusion with science journalism. Russell writes, “While these new tools – blogs, podcasts, Skype, Facebook, YouTube, and Twitter – offer creative outlets, mindless chatter can gobble up precious time. Countless new Web sites provide a dizzying array of science information, misinformation, and commentary that can be hard to sort through” (as cited in Allan, 2011, p. 774). Here, Russell sees the unlimited range of science information online as a potential harm for the accuracy and quality of science reporting. But she explains that the tenets of journalism must remain despite all the changes currently happening to the industry, such as the values of accuracy, expert sources, the belief in context above controversy and editorial independence (Allan, 2011).

However, digital media also can provide the unique ability for better dialogue with science news consumers, more transparency and trust in the news organizations (Allan, 2011). University of British Columbia Graduate School of Journalism professor Alfred Hermida

believes that "…science journalists should adopt a digital mindset, one that retains the values of accuracy and fairness while seeking to capitalize on the non-linear, interactive, and participatory nature of social networks in online environments" (as cited in Allan, 2009, p. 12). The Internet also provides the opportunity for interactivity, as user comments or concerns can actually be handled through the ability to edit the articles posted to websites at any given time (Secko et al., 2011).

But even with the popularity of digital media, newspaper content still drives other media coverage. In fact, one study found that more than 99 percent of links in blog posts reference original reporting or commentary appearing first at traditional legacy media (New media, 2010). And while the traditional media continues to continue to attract readers, online science news does so in its own unique way as well. The "participatory, social and collaborative" nature of digital science news has resonated with consumers (Fahy & Nisbet, 2011, p. 782). A third of Americans have said that they have taken part in the creation of news generally, commented about it, or posted about it on social media (Purcell et al., 2010).

Scientists' Importance in Communicating Science

In order for science communication to exist, the scientists who are directly involved with the science have to be willing to share their research and perspectives with the media. Scientists, journalists and the public can find it difficult to communicate effectively with each other, and how scientific research is presented in the news can affect public perception of science. Though 57 percent of U.S. adults say that the media does a good job covering science news, when asked what the problem was with news about scientific research, 73 percent of respondents said that the

problem had to do with how journalists covered science news and 24 percent put blame on the researchers' efforts towards communication of their science (Funk et al., 2017).

Scientists do have important responsibilities in the communication of science to the public. Public communication of science serves a multitude of purposes including "ensuring people are informed about scientific issues," "getting people interested or excited," "demonstrating the scientific community's expertise," "hearing what others think about scientific issues," "demonstrating that the scientific community cares about society's well-being," "demonstrating the scientific community's openness and transparency," "demonstrating the scientists share community values" and "framing research implications so members of the public think a topic resonates with their values" (Besley et al., 2018, 712-713).

One study that surveyed research practitioners at the Madrid Science Fair found that scientists' interests in communicating with the public included the "desire to increase the public's interest in and enthusiasm for science, the public's scientific culture, and public awareness and appreciation of science and scientists" **(**Martín-Sempere et al., 2008, p. 349). Other motivations found in another study include to create "a more positive attitude toward research" and for "a better educated general public" (Peters et al., 2008, p. 204). Furthermore, reasons differed based on the level of experience of the scientific researchers. While senior researchers felt a "sense of duty," "personal satisfaction and enjoyment" were more important reasons for the younger researchers **(**Martín-Sempere et al., 2008, p. 349).

Other factors that govern the willingness of scientists to share their research revolve around their relationships with journalists. A 2006 Royal Society Poll showed that scientists believe there is value in staying in contact with journalists (Royal Society, 2006). In fact, a 2008 study of researchers from the United States, France, Germany, United Kingdom and Japan

showed that in a representative sample, 30 percent of scientists had over five media contacts over the past three years and 39 percent said they had one to five media contacts (Peters et al., 2008). And in these relationships, 57 percent of researchers said that they were happy with their most recent encounter with the media. They cited that the journalists "asked good questions, used information accurately, explained the research well, and included the important information" (Besley & Nisbet, 2011, p. 651). In general, the scientific researchers relay that the journalists have done well in spreading scientific literacy and also helping advance the researchers' careers (Besley & Nisbet, 2011).

But this is not to say that researchers don't have serious criticisms for how journalists report on science. A 2009 Pew study showed that whether they have major or minor concerns, scientists mostly have a negative view of science coverage (Kohut, 2009). Specifically, scientists said they don't like to communicate their science because of mistakes that journalists make, particularly the "risk of incorrect quotation" and the "unpredictability of journalists." Both these reasons highlight the lack of control that researchers feel they have on the journalists' reporting (Peters et al., 2008, p. 204).

Scientists are increasingly asked to bring their research to the public, which can present difficulties. In the Royal Society survey, almost a quarter of polled scientists said that the primary or secondary reasons for them not engaging with the public more was because they didn't want to draw negative attention toward their work (Royal Society, 2006). Additionally, in a Wellcome Trust Study, 44 percent of scientists said they thought the public viewed them as "uncommunicative", 46 percent said the public thought they were "secretive" and 58 percent said they thought scientists were seen as "detached." This fear of the public's perceived negative feelings toward them holds them back from communicating more (The Role of Scientists, 2001

p. 12). And although they do not hold back on criticism of the science media, the Wellcome study showed that 53 percent of scientists believe the lack in education of the public is the most influential impeder of a greater understanding of science (The Role of Scientists, 2001). The Pew study results also indicated that almost 85 percent of scientists thought that the public knowing very little about scientific topics was a major problem for science (Kohut, 2009). But one science communication study says that if researchers were trained earlier to become more capable scientific communicators for the general public, this would significantly help address the issues regarding science communication (Brownell et al., 2013). Critchley's 2008 study found that publicly funded university scientists were trusted more by the public than privately funded industry scientists. This increased trust in university scientists was because of the public's perception that they were more motivated by benevolence, or working for the common good, rather than economic considerations, in contrast to the private researchers (Critchley, 2008).

Student Media and Science News

One challenge with news about science, however, is finding a way to capture the attention of younger audiences and give them a reason to keep engaged with the content. A study published in *Journalism Practice* examined the ways in which journalists covered a student-produced event regarding citizen science and sea level rise. Students participated in interviews and focus groups to provide a deeper understanding of how successful they thought the journalists were in covering the event. They said that the journalists didn't seem interested in the students and their science activities. As one student put it, "[Journalists] were very focused on the event, but a lot of times they did not even really talk about the people that were involved or

the kids that were doing the science and how they might eventually influence future generations to actually make a change" (Gutsche et al., 2017, p. 71). Those students said that this mistake cost journalists the ability to engage with the local community. Students said the one coverage team that was able to really stress the science and its effect on people was the Weather Channel. One student said this was because, "The Weather Channel was the only one who spoke to the people. They humanized the story a bit, they spoke to the residents, and a lot of the newscasts lacked that" (Gutsche et al., 2017, p. 72).

Therefore, much remains to be understood regarding student attention to science news. This thesis aims to examine the communication of science at the university level by looking specifically at the online coverage provided by student media outlets at a large research university. A content analysis was conducted to provide a clearer picture of past coverage of science and scientific research, and focus groups were also used to provide a deeper understanding of both the perspectives of the student journalists themselves and the student audience. Additionally, interviews were conducted with university principal investigators and professional science journalists in order to provide perspectives regarding the relationship between researchers and journalists, and how it affects scientific research coverage. The information found through these methods will be used to answer the following research questions:

RQ1: How are the relationships between student journalists and the research community—particularly the principal investigators?

RQ2: How can student media outlets effectively bring more attention to their news coverage of the important scientific research being conducted at the university?

RQ3: What types of news stories about science spark more interest, understanding and engagement from the student audience?

Chapter 3

Methods

Quantitative and qualitative methods were used to assess both past coverage on scientific research in student media and to understand audience preferences of science reporting. First, a content analysis was designed to analyze science news content, and then interviews and focus groups were conducted to explore students', scientists' and journalists' perceptions of science news in different formats.

Content Analysis

One of the first objectives of the study was to assess how science and scientific research has been presented by student news media. In order to do this, a content analysis was performed of student media science content. Two Penn State student media outlets were used to carry out the content analysis—Onward State and the Daily Collegian. According to the website of Onward State, which was founded in 2008 and has over 150,000 Twitter followers, the news site is:

> [A]n independent, alternative Penn State blog that seeks to foster the student voice through the combination of commentary that is fair, authentic, and sometimes humorous; analysis that is critical and irreverent; and news that is relevant and accurate. Onward State works to generate honest conversation in the hopes of enriching the Penn State community and experience. (History, n.d.)

The Daily Collegian is the independently published and student-managed newspaper at Penn State. Founded in 1904, the newspaper was published five days a week until the spring of 2018. That spring, the newspaper began to publish biweekly on Monday and Thursday, in addition to its daily online coverage. So while Onward State solely operates online, the Daily Collegian has both a print and online presence. However, this study focuses solely on the digital presence of both outlets because of the increasingly digital nature of news, especially on college campuses.

First, the outlets' websites were searched for all science stories published in the last five years, from Feb. 1, 2014 until Jan. 31, 2019. The keywords that were used on both websites were "scientific research," "science" and "research." The articles were reviewed to ensure they were stories focused on science and scientific research. Out of the 173 total science stories found, 61 were from Onward State and 112 were from the Daily Collegian. From this, a randomly selected sample of 75 stories was coded, with 30 from Onward State and 45 from the Daily Collegian. Because more science stories were found on the Daily Collegian in the past five years, a higher number of stories were coded from the Daily Collegian than from Onward State, in order to give a more representative sample of the science content that has been published by the student media outlets. A small number of opinion articles about science news were included in the sample in order to represent non-news stories about science.

The stories were coded for the number and type of sources who were quoted in each science story, what type of story it was, which scientific research topic(s) the stories focused on, whether the lede was person-centered and whether there was a visual element present within the story that was related to the scientific information being written about (see Appendix A).

In addition to this, analytics from the outlets' websites were obtained to get a measure of audience engagement and attention to the articles in the sample. Both Onward State and the

Daily Collegian provided metrics for the articles in the study's sample of science stories. Average page views and time spent on page were the metrics used to check audience engagement. To determine potential reasons for the higher popularity of certain stories, the five most viewed stories' metrics from each news site were analyzed with their coding results. The average time spent on each site's science stories was also compared to the average time spent on general stories from their own sites.

Interviews

To understand the perspectives of the scientists behind the research being written about, interviews were conducted with two principal investigators of research projects and two professional science journalists. These interviews will remain anonymous in concordance with IRB regulations. The principal investigators answered numerous questions regarding their relationships with journalists and their responsibilities in science communication (see Appendix B). The professional science journalists answered a variety of questions pertaining to their experiences in the field, their relationships with scientists and their view about how science could effectively be communicated at universities by student journalists (see Appendix C).

Focus Groups

Four focus groups were conducted to provide a deeper understanding of the student perspectives of student-produced science news. Snowball and convenience sampling were used as recruitment methods. Two focus groups consisted of students who are majoring in a scientific discipline; each had three participants due to time constraints of the participants. Another focus

group included three science and five non-science majors, totaling eight participants. The final focus group was made of five student journalists from the student media outlets at Penn State. During the focus groups, all participants were assigned a unique number to maintain anonymity.

The student journalists' focus group asked questions about the journalists' current science coverage on campus. In contrast, aiming to test their science news consumption preferences, the science and non-science majors were given two student media science articles and a news video focused on research laboratories and the research being conducted in them. These instruments were chosen to be utilized in the focus groups because they best provided the ability to answer the research questions of the study. The first article was published on Onward State in 2015 and described the development of a more efficient solar panel because of work by a Penn State engineering research team (see Appendix D). The article was an example of hard news because it did not show a focus on the people behind the research efforts. Additionally, the lede had no human-interest angle, since it was without a reference to a specific person. One person was quoted in the story. The story was 540 words, an example of a story shorter in length. And because the researcher was an engineering professor, the article's science topic was engineering.

The principal investigator of this study wrote the second article used in the focus groups with science and non-science majors. It was published by Onward State in 2018. This article was selected for the focus groups because of its strong human-centered focus, an essential factor to test for in this study to answer the study's third research question (see Appendix E). Specifically, the article highlighted a research laboratory on Penn State's campus led by a biology and biochemistry professor. The lab's research focused on how changes in the genome can cause neurodevelopmental disorders such as autism or schizophrenia. This was a feature article because it demonstrated a strong focus towards the people within the lab, while also talking

about research. The article also had a human-interest lede because of its specific reference to the professor in charge of the lab at the beginning. Because the researcher was a biology and biochemistry professor, this story's science topic was biology. Four people were quoted in the study. The article was 1,377 words, a longer length for a science story.

Additionally, the principal investigator of this study also produced the video published on Onward State in 2018 that was shown during the science and non-science major focus groups. The video detailed the work being done by a neuroscience laboratory on campus and was just over two minutes in length. The principal investigator's video was used as an instrument in the focus groups because of a lack of video content about science news on either student media outlet. However, by removing the principal investigator's name from both the byline of the second article and from the video, the focus group participants were blinded from this information and participant objectivity remained intact.

After having read the two articles and watched the video, the science and non-science major focus groups consisted of a written portion and a verbal discussion. The student journalist focus groups also had a written portion and verbal discussion. For the written part of the focus groups, participants were asked to complete a worksheet depending on their background that consisted of 16 open-ended questions for science majors, 11 open-ended questions for non-science majors and 10 open-ended questions for student journalists (see Appendices F-H). The questions were then used for the verbal discussion. The interviews and focus group responses were analyzed for emerging themes.

Chapter 4

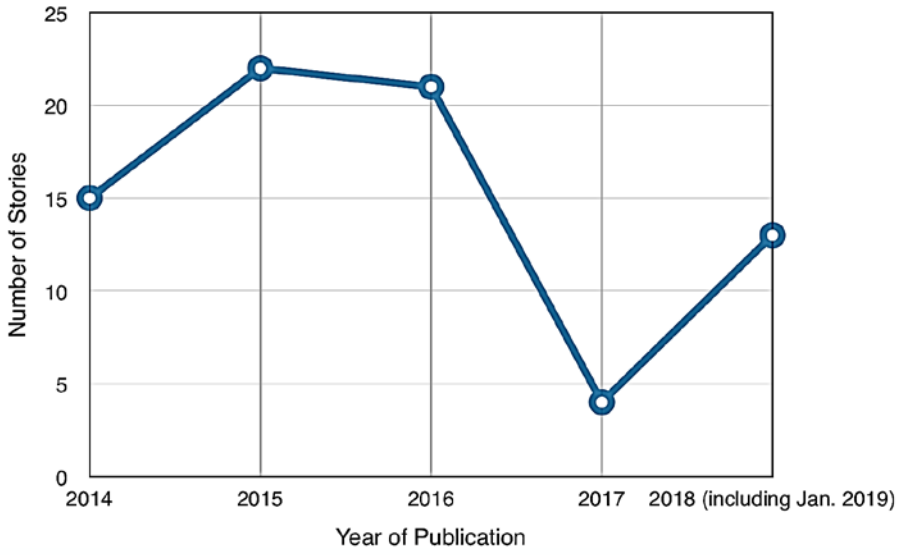
Results

Content Analysis

The results indicated that the number of science news published in the student media sampled here decreased in 2016-2017, but began to increase again in 2018. Almost half of the stories were 500 words or fewer. The Daily Collegian's science stories used more sources per story than Onward State and also employed a variety of sources. The Daily Collegian wrote more features than hard news articles about science, while the opposite was true for Onward State. Biology, medicine, or at least two scientific topics were the focus of most of the stories, but none about chemistry were found in the sample. Both news sites had a minority of their stories feature a human lede and a majority of the science stories accompanied by a related visual. A higher percentage of stories were found to contain a human-centered lede and related visuals on Onward State's website than that of the Daily Collegian.

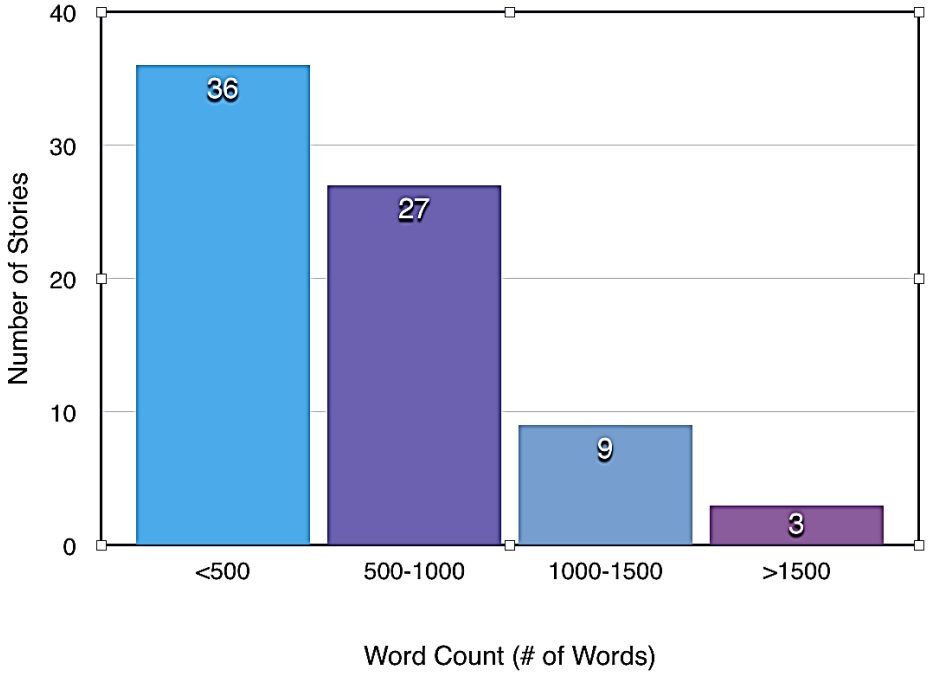
Figure 1 shows the frequency of science publication. There was a notable decrease in science stories published on both student media outlets' websites from 2016-2017. Onward State's random sample of 30 articles was found to have five, 13, eight, one, and three science stories published in 2014, 2015, 2016, 2017 and 2018 respectively. The Daily Collegian's random sample of 45 articles was found to have 10, nine, 13, three, and 10 science stories published in 2014, 2015, 2016, 2017 and 2018 respectively. Onward State published its most stories about science in 2016, and the Daily Collegian did so in 2015.

Figure 1: Frequency of Science Stories by Publication Year



Another objective of the content analysis was identify article length of the science stories on Onward State and the Daily Collegian (see Figure 2). The average word count for science stories on Onward State was 621 words; for the Daily Collegian, it was 648 words. All stories were at least 200 words long, while only one story surpassed 2,000 words in length. Though Onward State's average word count was less than that of the Daily Collegian, both outlets had six stories with over 1,000 words.

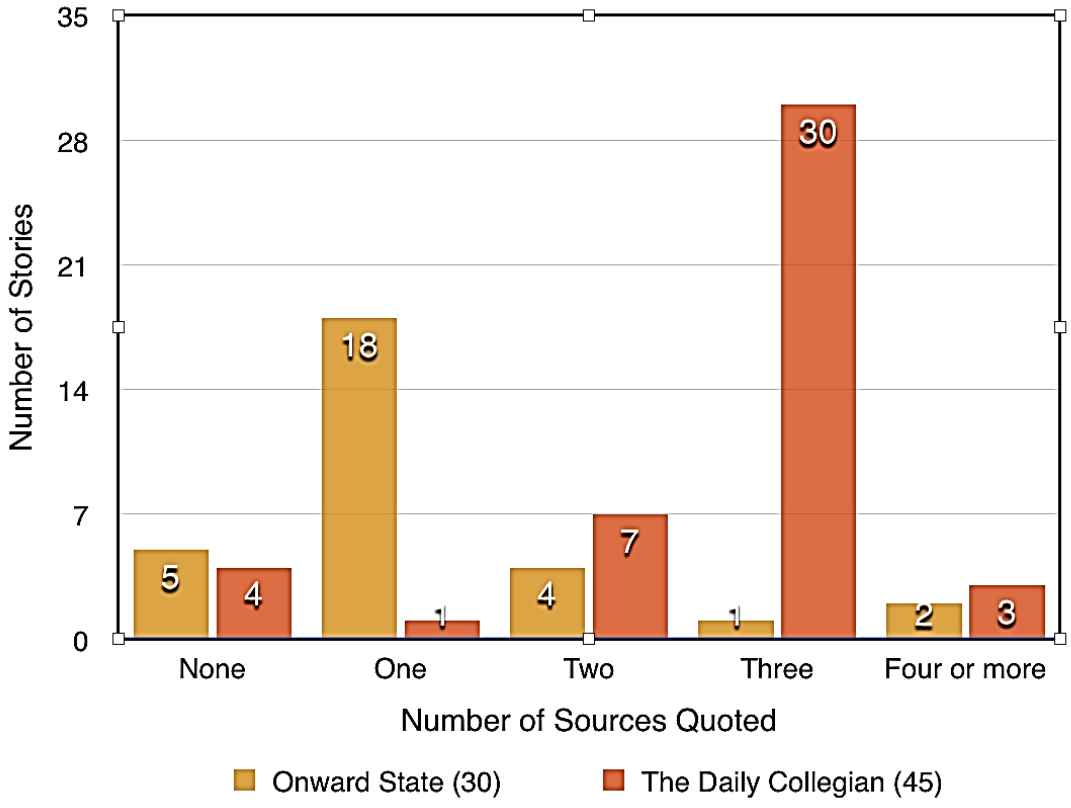
Figure 2: Frequency of Science Stories by Word Count



Onward State used fewer sources with direct quotes than the Daily Collegian (see Figure 3). The most common number of sources used for Onward State was one and for the Daily Collegian it was three quoted sources. That represented 60 percent of the stories for Onward State and 67 percent of the stories for the Daily Collegian respectively. Additionally, Onward State had five stories and the Daily Collegian had four stories with no quoted sources. The Daily Collegian had two quoted sources in seven of its science stories, while Onward State had two sources in four of its stories. Finally, four or more sources were used in two of Onward State's stories and three of the Daily Collegian's stories. In terms of variety of sources, the Daily Collegian had almost two-thirds of its sampled stories contain two different types of sources. Onward State's most common source choice in its stories was having quotes solely from the faculty associated with a particular research project. This was the case in over half of the stories

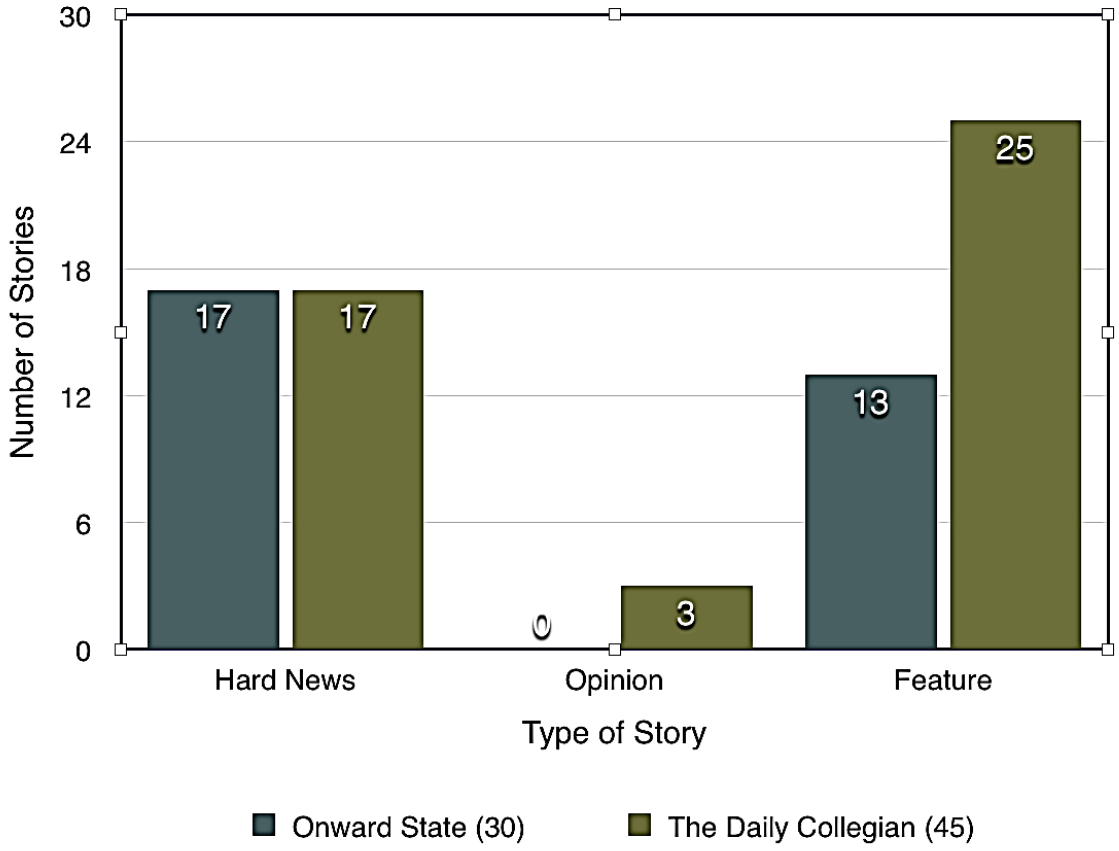
sampled from Onward State. Faculty not associated with a research project and community members were not quoted directly in any of the sampled stories. And although graduate students were never the sole source for the story, they were interviewed for some stories found on both Onward State and the Daily Collegian. Four stories from Onward State quoted only undergraduate students, while one story did that from the Daily Collegian. University administration was quoted in three stories on the Daily Collegian. Four of Onward State's 30 stories contained sources from two different categories, while one story contained sources from three or more different categories. Six stories that had sources from three or more different sources were found on the Daily Collegian.

Figure 3: Frequency of Science Stories by Number of People Quoted



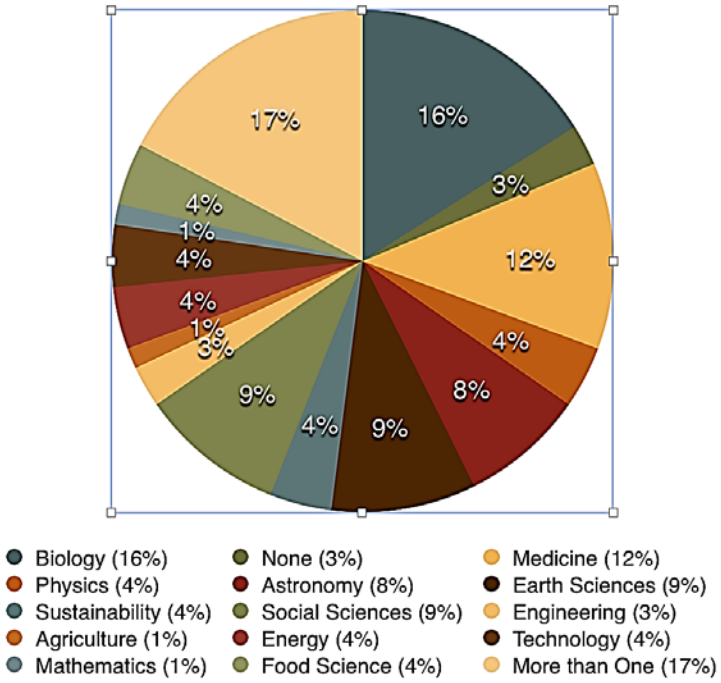
As shown in Figure 4, the study examined the types of science stories the student media wrote: hard news, opinion, or feature stories. Onward State and the Daily Collegian both published 17 hard news stories each. And while Onward State published no science opinion pieces, the Daily Collegian published three. Thirteen of the 30 Onward State articles were feature stories; 25 were in the Daily Collegian sample. Approximately 56 percent of the science stories sampled from the Daily Collegian were features and 57 percent of the science stories on Onward State were hard news.

Figure 4: Frequency of Science Stories by Story Type



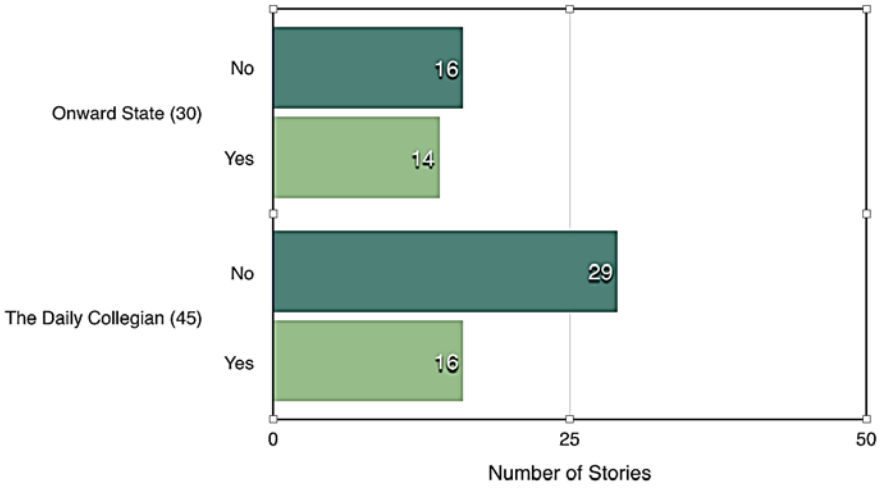
Another area of interest in the study was what particular science topics were covered in the stories written by the student media outlets. For this analysis, both media outlets' stories were pooled together. As Figure 5 shows, about 17 percent of the articles included mention of two specific different science topics, instead of one particular science topic. This represented the most stories within the 75 coded articles. The most-covered single science topic was biology, which was represented in about 16 percent of the stories. The second-most covered single science topic was medicine, which was the focus of about 12 percent of the stories. Next, earth sciences and social sciences were both represented in about 9 percent of the stories sampled. Astronomy was the science topic covered in about 8 percent of the stories. Physics, sustainability, energy, technology and food science were all the focus of about 4 percent of the stories. The 'none' category represented the science stories that did not mention any specific science topics, but instead focused on general science. In addition to engineering, about three percent of the stories did not focus on a particular science topic. Mathematics and agriculture were only the focus of one story each and so they each represented less than one percent of the science stories. Chemistry was not seen within the random sample of science coverage in the past five years.

Figure 5: Frequency of Science Stories by Science Topic



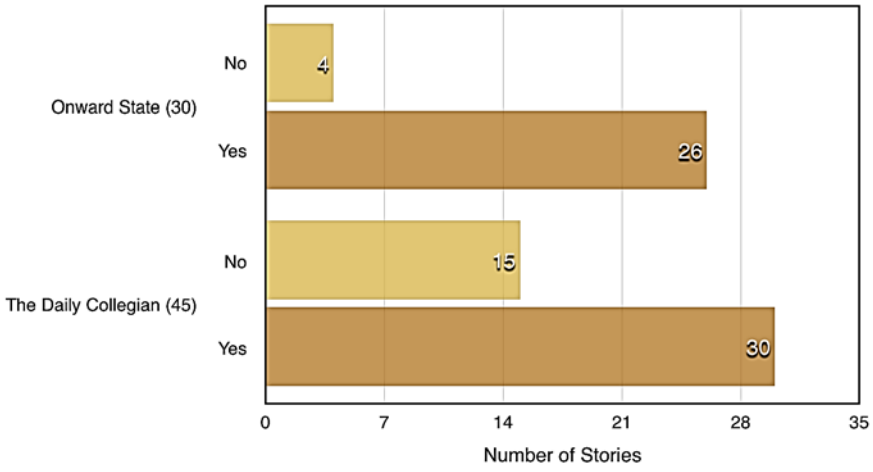
Onward State used a human-centered lede in 14 stories, or about 47 percent of the stories examined. The Daily Collegian used a human-oriented lede in 16 of its science stories, which represented about 36 percent of its sampled stories (see Figure 6).

Figure 6: Did the Science Story Use a Human-Centered Lede?



In addition, the content analysis checked to see if there was a visual component related to the story present. Figure 7 shows that the majority of stories on both websites contained visual elements. Twenty-six stories, or about 87 percent, of the stories from Onward State contained a related visual element. In the Daily Collegian's articles, 30 of the stories contained a related visual element. This constituted about 67 percent of its sampled science stories.

Figure 7: Did the Science Story Contain a Related Visual Element?



Metrics for page views and average time spent on the articles in the sample were obtained from both student media outlets' editorial staff and data for all the coded stories were analyzed by outlet. Additionally, the analytics of the five most popular science stories from each student media outlet are presented below (see Tables 1 and 2). The analytics from one Onward State story was disregarded because its average time on page was over 58 minutes long, an outlier.

Onward State's most viewed story had 10,973 views. The average time spent on this story's page was 3 minutes, 39 seconds (3:39). It contained a human lede, a related visual, 1,200 words, was a feature, discussed food science, had one person quoted and was from 2015. The second most viewed article from Onward State had 8,163 page views and people averaged

spending 2:09 on the page. It contained no human lede, had a related visual, was 419 words, was hard news, quoted two different types of people, was about biology, and was written in 2016. The third most viewed article on Onward State had 3,078 views and people spent an average of 2:42 on the page. It had no human lede, contained a human visual, was 540 words, was hard news, quoted one person, discussed engineering and was written in 2015. The website's fourth most viewed article had 2,007 page views and people averaged 2:54 on the page. It had a human lede, a related visual, was 1,093 words, was a feature, had one person quoted, was about medicine and was published in 2014. The fifth most viewed story had 2,005 page views and people spent an average of 0:39 on the page. It contained a human lede, a related visual, was 464 words, was a feature, quoted one person, discussed more than one science topic and was published in 2015.

Table 1: Onward State's Five Most Viewed Science Stories

	#1	#2	#3	#4	#5
Page View #	10,973	8,163	3,078	2,007	2,005
Time on Story	3:39	2:09	2:42	2:54	0:39
Year Published	2015	2016	2015	2014	2015
# Words	1,200	419	540	1,093	464
# People Quoted	1	2	1	1	1
Type of Story	Feature	Hard News	Hard News	Feature	Feature
Science Subject	Food Science	Biology	Engineering	Medicine	Multiple
Human Lede?	Yes	No	No	Yes	Yes
Related Visual?	Yes	Yes	Yes	Yes	Yes

The Daily Collegian's most popular story got 1,004 page views and people averaged 2 minutes, 35 seconds (2:35) on the page. It had no human lede, no related visual, was hard news, was 240 words, had one person quoted, was about medicine and was written in 2018. The second most viewed article got 792 page views and had people reading for three minutes. It contained no human lede, had a related visual, was hard news, was 608 words in length, quoted three people

from two different categories, was about astronomy and was published in 2018. The third most viewed Daily Collegian article got 536 page views and had people reading for an average of 5:45. It contained a human lede, a related visual, was 1,018 words, had zero quotes because it was an opinion piece, was related to medicine and was published in 2018. The fourth most popular science article on this site had 400 views and an average of 2:27 for time people spent on the page. It had no human lede, contained a related visual, was 667 words, was a feature, quoted two people from the same category and was written in 2019. The fifth most viewed story had 267 page views and people spending an average of 3:29 on the page. It had a human lede, a related visual, was 2,035 words, was a feature article, quoted four people from at least three different categories, discussed technology and was published in 2018.

Table 2: The Daily Collegian's Five Most Viewed Science Stories

	#1	#2	#3	#4	#5
Page View #	1,004	792	536	400	267
Time on Story	2:35	3:00	5:45	2:27	3:29
Year Published	2018	2018	2018	2019	2018
# Words	240	608	1,018	667	2,035
# People Quoted	1	3	0	2	4
Type of Story	Hard News	Hard News	Opinion	Feature	Feature
Science Subject	Medicine	Astronomy	Medicine	Biology	Technology
Human Lede?	No	No	Yes	No	Yes
Related Visual?	No	Yes	Yes	Yes	Yes

When looking at the analytics of all of the articles sampled from both websites, Onward State had an average of 1,435 views for each science story and an average of 0:53 for the time people spent reading them. The Daily Collegian had each story average 73 page views and 1:53 for time spent on each of the pages. While the Daily Collegian had eight stories get over 100 views, Onward State had no stories under 100 views. Five of Onward State's 29 sampled science stories had a higher average time spent on page than that of any general Onward State story. On

the Daily Collegian, 16 stories, or 36 percent of the sampled science stories eclipsed the Daily Collegian's general average time on page. The average time spent on each page for all the 45 sampled science stories from the Daily Collegian together was higher than the average time spent on each page for its general stories. The Daily Collegian had a higher average time on page than Onward State.

Interviews

Interviews were conducted with two university principal investigators and two professional science journalists. The principal investigators will be referred to as PI #1 and PI #2. The professional science journalists will be called Journalist #1 and Journalist #2.

Principal Investigators

Both principal investigators discussed perceived issues with student media coverage of science, particularly about the disconnect between scientists and student journalists. Both mentioned they don't read the student media outlets' websites for science news or activities, and at the same time, their perception that students don't understand research activities:

> "Right now certainly I wouldn't go to one of those [student media outlets' sites] thinking I was going to find something about science. I would go to those sites if I wanted to see if Penn State won a football game," PI #1 said.

> "I can tell you that I'm not aware of a lot of things that's going on in terms of student activities as well," PI #2 said. "None of those come to my attention, or the attention of people like me. [At] the same time, students don't know about the types of things we do in laboratories."

PI #1 said that a reason students might be hesitant to cover research endeavors more at Penn State is because of the complexities of the topics.

> "It's challenging for journalists to write about science because science is incremental and because scientific findings don't lend themselves into making the most straightforward article…" PI #1 said.

In addition to this lack of understanding, however, PI #2 also thought that the journalists' focus is just on different topics than scientific research.

> "It's not that [they're saying], 'Oh I don't understand what you do so I don't want to write about it.' It's just that they don't know that we exist just because you are focusing on something which they think is a hot topic to cover," PI #2 said.

Both researchers said they have a responsibility to communicate their research to the public.

> "I think that it's a huge responsibility on the scientists or the principal investigators to make sure what they do in the laboratories is communicated back to the public because we are using taxpayer dollars to do our work," PI #2 said. "And the implications of our work need to be communicated out to the public."

PI #1 agreed that the fact that university scientists are publicly funded is one of the biggest reasons why they need to communicate their findings to the public. However, instead of student media, institutional communication mechanisms were mentioned, such as a departmental website.

> "There are a lot of Penn State people all the time publishing great things in the literature. So I guess we can't all go to Onward State every time we publish something and say, 'Here, write an article about me.' But, on my departmental website, that's certainly feasible. I mean we want to showcase the great work being done…" PI #1 said.

PI #2 also utilizes the resources provided by Penn State, but realizes that this is not what the student audience reads on a daily basis. PI #2 gets most of his news on social media—specifically Twitter.

> "Many people, including me, I get my news through Twitter. The first thing I do in the morning when I get a chance to open my phone is I look at Twitter," PI #2 said. "Also, I get most of my science news through Twitter. People tweet, retweet

> and they promote their [own] or other people's research. And I see also that there's a lot more attention that is gained when you tweet rather than when you publish a paper and nobody really notices."

With all of the misinformation posted on social media, PI #2 thinks the platforms' ability to provide the opportunities for immediate responses are very important to maintaining accountability. PI #2 also believes that there is a better way to cover the science done in research laboratories.

> "The best way to do it is to first observe—watch what people are doing—just be a fly on the wall," PI #2 said. "So that will probably give you a better perspective of how people think, how they really evaluate information, and how they test a hypothesis and then go after it with experiments."

PI #2 encourages journalists to ask for clarifications on the technical jargon that most likely will be used during prospective interviews. This would help avoid potential misunderstandings. And in order to put the scientific terminology in layman's terms, PI #1 knows that both sides play a role.

> "I think it requires efforts on both sides. I'm used to talking about things to other scientists," PI #1 said. "So I might not have the right kind of skills to make it go all the way to where it needs to be for the [journalists'] readers to find it accessible. But if I can get it accessible enough for [the journalists], then I can

> leave it up to [them] to do the rest of the job and make it accessible for the readers."

Besides doing homework beforehand to get necessary background information, one way that PI #1 thinks could help allow for the story to be as accurate as possible is if the journalists worked with the principal investigators before publication to make sure that all the scientific information that the journalists made more understandable was still accurate. PI #1 said the ability to ensure accuracy would allow him to put his trust in the journalists more.

> "Usually [the science is] not completely wrong, it's just kind of wrong. But you see that quite often. And so if it were an article written about my work, I would want to try and hide that off, and make it be as correct as it can be. Because, you know, part of what you're trying to do is teach," PI #1 said.

In addition to aiming for accuracy, interest is also an important component to the science stories according to both principal investigators. PI #2 said that this can be done by including the stories of the people who work in the laboratories.

> "That's [why] I think students should spend some time in the lab. Getting to know the people who do the science before knowing the science—that's important," PI #2 said.

According to PI #1, researchers look for a few things from journalists' stories on their work.

> "Let's try to make it as interesting as possible, but also let's try not to sensationalize it and make it seem like we're accomplishing more than we actually are," PI #1 said. "Let's try and make people understand that yes science is hard and at best we can get from Point A to Point B. And we should be excited about that."

Professional Science Journalists

The professional science journalists said that it is both hard to find the right science stories to cover and to capture the readers' attention at the start. One suggestion to draw readers in was finding a human-interest angle. One journalist also said that it can often help to not be specialized in a science topic when writing about it for others to understand.

According to Journalist #1, one of the most difficult parts of covering science is finding the right stories—the first step in the scientific journalism process.

> "I think that the first thing to do is find the right stories. There's a lot of information out there, there's a lot of researchers out there to cover and every field and every area of scientific research is worth covering. The real trick to engaging readers is finding a story inside one of those areas of research that is going to be really interesting and really engaging to someone who's entering that field for the first time," Journalist #1 said.

Journalist #2 said that one of the hardest jobs for science journalists is maintaining research attention because of readers' tendencies are to "shut down" if they don't understand something. That is why Journalist #2 thinks adding a human element to a story towards the beginning might help.

> "I think the value is that we're humans. We are interested in stories about other humans. We instantly relate. It's not that a story without the human aspect isn't always interesting, because it can be—it can be fascinating. But for a lot of people and a lot of readers, that gives people a way in," Journalist #2 said. "It gives you a way into the coverage, it gives you a way in to think about it and understand it, and maybe understand its relevance to our lives."

Journalist #1 also believes that there is great value in adding human-interest angles to science stories.

> "If the opportunity is there to show a really interesting story that involves people that are doing the science or involves people whom the science affects, then that should definitely be part of the story," Journalist #1 said. "I think we sort of know instinctively as storytellers and also through a lot of research that the thing that people connect to the most are other people."

Another important aspect of science journalism according to the professional science journalists is the need to bring understanding to a topic.

> "Make sure for a general audience that you're not dumbing it down for them, but you are also not making it inaccessible and dense. Making sure there's accessible information—you break it down where you need to, you're not using too much jargon, you can use metaphors when possible to help make things more understandable," Journalist #2 said.

Journalist #1 sees general journalists at a possible advantage when trying to convey understanding to a general audience because scientifically specialized people may have a harder time separating themselves from the language used within their field.

> "Covering science is very different from doing science…In terms of a specific skillset, it's more important to have like strong journalism fundamentals than it is to have a strong foundation in scientific knowledge," Journalist #1 said.

Journalist #2 also said that questions are the key for those journalists who don't necessarily understand what the scientific researchers are explaining to them at first.

> "Questions are the way to get into it. And to realize there are no dumb questions. They just say, 'Assume I know nothing. Help me understand this. Help explain it to me,'" Journalist #2 said.

Another method to helping write a story without a scientific background is to clarify uncertainties with the researchers after writing the story.

> "If something is sort of really complicated and I've tried to make it accessible, I also want to make sure I've gotten it right," Journalist #2 said. "And sometimes that means if it's something that I'm not quite sure about, I'll never run a whole story by a source, but I'll sometimes run a paragraph or two by [them] and just be like, 'Did I get this right?'"

Journalist #1 also believes that the audience for science articles exists just like any other story topic as long as the content is interesting.

> "My impression is the majority of people are just going to read whatever is in front of them—that seems interesting to them, that engages their interest," Journalist #1 said. "And I think that science has an incredible advantage in this area because we can appeal about things that have a really powerful significance to one's health, to one's life, to the technology that is woven through our society and governs much of the way we live."

Willingness from both journalists and researchers are necessary for effective science communication according to Journalist #1.

> "I wouldn't say that the burden is fully on the scientists and researchers to talk about their research. I mean, I think that we share that burden to bring this information to the public," Journalist #1 said.

And when the right science stories are found, there are responsibilities that the journalists feel they need to carry out.

> "The first priority that we have is accuracy—factual accuracy. We want to make sure that we are getting everything correct. And we're getting the story correct and we're portraying the scientists and their position accurately," Journalist #1 said. "Then the second priority is to make this information engaging to the public and make it interesting to people, and show how it's important to know this stuff…"

The professional science journalists also provided advice to student reporters trying to cover science without a scientific background. They both had the same advice—to constantly ask questions.

> "I'd say don't be intimidated even if you don't know that much about it. That's why you're as journalists—question askers. So ask the right questions. And ask a lot of questions," Journalist #2 said. "Can you in a matter of like a few interviews with somebody get up to speed to be an expert on this topic? Of course not. But,

you can be enough of an expert to hopefully relay that to your readers and make it worthwhile."

Focus Groups

Four focus groups were held and had a total of 19 participants. While one focus group contained only student journalists, the other three focus groups were held with a diversity of science and non-science majors, representing the student audience for science stories. The three student audience focus groups specifically contained nine science majors and five non-science majors.

Student Audience

The science and non-science majors showed a common preference for human-interest stories, the importance of a captivating lede, depth of reporting mattering more than the length of the article and also that the more engaging article enabled more learning. Participants in science and non-science focus groups said they not only liked hearing about other people, but also believed that the key to relating the science to the general audience was by showing the impact the science has on the general population. It was also observed that people thought not enough science was being distributed by student outlets on campus, that social media was a major way to get news, that PI's need to do more, and that student journalists have an importance as 'middlemen' in the process of science communication.

For the three focus groups with science and non-science majors, two different Onward State articles were presented to the participants to discuss which article they preferred. The

participants also watched a video about the work being done by a campus laboratory that was published on Onward State. However, for the video, no common theme was found as opinions were split as to whether the video was effective in communicating the science being discussed within its short amount of time. The two articles were vastly different in style so that a concrete opinion could be generated. The results from that activity showed that article No. 2 was the more popular article among focus group participants. Of the 14 student audience participants spanning the three different focus groups, 12 of them preferred article No. 2. So although two participants liked article No. 1 better, the opinion of the majority was that article No. 2 was preferred over article No. 1. There were a variety of reasons given for this majority opinion from focus group participants, amounting to six emerging themes found during the discussion. Those themes observed from the majority of focus group participants were that article No. 2 presented a more captivating lede, a human-interest angle, higher quality of writing and a more useful related visual. Its length was also not a problem and it allowed for more learning.

As Table 1 notes, the audio recording from the discussion was used to find statements made by focus group participants that supported the emerging themes that were observed. First, article No. 2 was said to have a more captivating lede. This was supported by focus group participant 2:7, a non-science major, who said:

> I liked the second article because I think that it draws the reader in at the beginning. And I think the beginning of an article is really important because that determines whether or not you're going to continue reading. It starts more like a narrative, like your picking up the beginning of a book.

Another emerging theme that was found was that focus group participants enjoyed the strong human-interest angle found in the second article. Focus group participant 3:3, a science major, said:

> I liked how we kind of got the story of the lab and the different people that are working there, and what they're working on. So I kind of found myself more invested in their work and wanting to know what they were doing. I like how there was more of a personal feel to it.

Focus group participants also took notice of the quality of writing found within both articles. Again, the majority of participants said that article No. 2 was better in this regard. This was not only because it was better written, but also because it had more depth in its reporting—for example, more sources used and the inclusion of a variety of types of sources. Focus group participant 3:2, a science major, took note of this:

> [In] the first article, I think the quotes were mainly from one person. But the second article like quoted more than one person. So we got different insights into the same topic, which I think was more useful than having just one person try to explain it.

Most non-science majors also did not feel like the length of article No. 2, which was 837 words longer than article No. 1, was an issue for them. Non-science focus group participant 2:5 said:

> I think length is inconsequential if the subject matter is interesting.

The visual element attached to each article was also a point of discussion. Focus group participant 2:2, a science major, liked seeing the people in the lab in the image included with article No. 2 and said:

> Also, the second one had an image. And that allowed me to add a face to a name behind the research lab.

Finally, although not all non-science majors felt the material presented in the second article was as understandable as that presented in the first article, both science and non-science majors believed that they learned more from the second article. Non-science major and focus group participant 2:4 said:

> I liked number two better. Article one was just very dry; it didn't really connect with me in a learning aspect. I didn't really think I learned anything from that. [It was] just like a lot of concepts that were just like on a page. And number two kind of flowed more effortlessly. So I could kind of grasp some of the things that I didn't think I could understand before.

Table 3: Reasons Why Student Audience Preferred Article 2 in Focus Groups

Emerging Theme	Quotes from Focus Group Participants
Captivating Lede	**SM 2:2** = "It was way more interesting. Part of the reason for that was there was like a really interesting hook to the second one that was about something that wasn't even related to science. And it really captured my interest."
	SM 3:2 = "[For] number two, I agree that I thought starting out with the story of the researcher was good because it did really draw you in."
	NSM 2:7 = "I liked the second article because I think that it draws the reader in at the beginning. And I think the beginning of an article is really important because that determines whether or not you're going to continue reading. It starts more like a narrative, like your picking up the beginning of a book."
Human-Interest Angle	**SM 3:3** = "I liked how we kind of got the story of the lab and the different people that are working there, and what they're working on. So I kind of found myself more invested in their work and wanting to know what they were doing. I like how there was more of a personal feel to it."
	NSM 2:6 = "And it was also story-centric. I learned more about the person behind the research, which I think as a non-science major I find that as much as it is valuable to learn about the research, I think it 's valuable to find the motivation behind the research."
Length A Non-Factor for Non-Science Majors (NSM)	**NSM 2:5** = "I think length is inconsequential if the subject matter is interesting."
	NSM 2:6 = "Even though it was shorter, I still thought it read longer because I didn't feel like it was more of like a story. It was more just like one person explaining a topic."
Quality of Writing--Better Written and More Depth of Reporting	**SM 2:1** = "I liked the second one better, I thought it was a little bit easier to read and a little bit better written."
	SM 2:2 = "I also enjoyed the second article hands-down. I thought it's better written. There's also no typos."
	NSM 2:5 = "I would also agree that I liked article two better. Even though it was a little more difficult to understand as a non-science major, it was better written than the first one."
	SM 3:1 = "I also liked the extensive use of quotes in article two because that helped me to explain through the researchers own words about what kind of projects they were working on."
	SM 3:2 = "I also really like all the different quotes and the number of different people interviewed because it had like a bunch of different perspectives from different people…"
	NSM 2:6 = "[In] the first article, I think the quotes were mainly from one person. But the second article like quoted more than one person. So we got different insights into the same topic, which I think was more useful than having just one person try to explain it."
Related Visual	**SM 2:2** = "Also, the second one had an image. And that allowed me to add a face to a name behind the research lab."
Learned More From It	**SM 2:3** = "I liked article number two better because while I didn't necessarily understand the content that was presented as much, I definitely learned a lot more from it. Whereas, I understood the words that were written in article one better, but I didn't feel I learned as much from the article."
	NSM 2:4 = "I liked number two better. Article one was just very dry; it didn't really connect with me in a learning aspect. I didn't really think I learned anything from that. [It was] just like a lot of concepts that were just like on a page. And number two kind of flowed more effortlessly. So I could kind of grasp some of the things that I didn't think I could understand before."
KEY: SM=Science Major & NSM=Non-Science Major; Focus Group #: # Assigned to Participant	

The science and non-science major focus groups also answered questions regarding their own science news consumption patterns. From these answers, themes were observed, as shown in Table 4. A common answer from the participants was that they don't see very much science news around campus. Focus group participant 1:1, a science major, said:

> I don't see a lot of science being advertised around the university…The only time I hear of any scientific work that's being done is word of mouth from friends who are in those research labs.

Many of the participants also said that because they don't actively seek out science news, they don't see it very much, but that they would read it if they happened to come across it. A non-science major, participant 2:6, said:

> I don't like seek out articles that are related to science, therefore I don't see many articles. But I think that if I were to be presented more articles I would read them more.

Some outliers were found in terms of seeing science information from other sources. Two participants noted that they read Penn State emails that contained science and another said that they saw science news on bathroom stalls. However, the majority of participants did not find science coverage in these ways. Social media was a major way that the students felt science news could be distributed, despite some inaccuracies that plague the platforms. Focus group participant 3:3, a science major, said:

> One, I think that it's kind of the avenue it has to go down because that's where the people are getting their news. So if it's not going down that avenue then people aren't reading it. And two, I was going to say, I think it does depend on the news source, like if it's a reputable source. I mean if you click on an article and like you've never heard of the publication, I would be a little more wary to trust it. But if it was like, *Nature* or something like that, or Onward State, then I would probably trust it.

The participants leaned heavily towards wanting to see more science content, especially because they were interested in all aspects of campus life. Focus group participant 2:6, a non-science major, said:

> I'm definitely interested in learning about what students are doing around campus, specifically regarding research, so I would definitely read them.

Table 4: Science News Consumption around Research University

Emerging Theme	Quotes from Focus Group Participants
Don't See Much Science News Around Campus	**SM 1:1**= "I don't see a lot of science being advertised around the university… The only time I hear of any scientific work that's being done is word of mouth from friends who are in those research labs."
	NSM 2:4= "I hardly see any scientific anything. And I think that's probability the difficulty of access. So what I think about that is I don't really have enough exposure to any [science] articles…"
Don't Actively Seek Out Science News, But Would Read If Came Across It	**SM 3:1**= "As a science major I do find those articles interesting when I happen upon them. So I think that if they were, you know, being shared more, like if I was just seeing them more, I would be more into reading them."
	NSM 2:6= "I don't like seek out articles that are related to science, therefore I don't see many articles, but I think that if I were to be presented more articles I would read them more."
Despite Some Unreliablity, Social Media Is An Inevitable Mode of News Consumption	**3:2 SM**= "I feel like it's such a common method now, how news is spread, like it will be [the way news is distributed]."
	SM 3:3= "One, I think that it's kind of the avenue it has to go down because that's where the people are getting their news. So if it's not going down that avenue then people aren't reading it. And two, I was going to say, I think it does depend on the news source, like if it's a reputable source. I mean if you click on an article and like you've never heard of the publication, I would be a little more wary to trust it. But if it was like, Nature or something like that, or Onward State, then I would probably trust it."
Desire For More Science News Because Of Interest In Campus/Student Life	**SM 3:3**= "I think that Penn State prides itself on being a research institution. So I don't know why we aren't highlighting these things like just as much as sports."
	SM 3:1= "I did think it was interesting, as participant [3:3] said earlier, you get to hear about different kind of projects going on around campus that you didn't know about before. It's cool to see like what's all going on just here at the university and I enjoy hearing that. So I would like to see more [science stories]."
	NSM 2:6= "I'm definitely interested in learning about what students are doing around campus, specifically regarding research, so I would definitely read them."
KEY: SM=Science Major & NSM=Non-Science Major; Focus Group #: # Assigned to Participant	

The science majors in the student audience focus groups felt that principal investigators play a role in the science communication on campus. There were three themes found among their answers regarding the involvement of principal investigators in the issue as shown in Table 5. The participants first thought that principal investigators don't show much of an interest in student media coverage. Focus group participant 1:3, a science major, said:

> I don’t think that they are extremely motivated to reach out especially to the students, or just Penn State public in general. I think they more have their eyes focused on publications in scientific journals.

Additionally, the majority of focus group participants felt that principal investigators have a responsibility to talk to student journalists for a variety of reasons. Focus group participant 3:1 and science major said:

> They're in a university setting and their main job here is well to research, but also to educate the student body.

The focus group participants also thought that principal investigators could see benefits from their willingness to share their interesting research endeavors with student media outlets. Focus group participant 3:1, a science major, said:

> It’s important to reach your student body too because they’re the ones that supply a lot of the work as undergraduates in labs. So you want to get them interested and excited about [research] too.

Table 5: Student Audience's Thoughts on Role of Principal Investigators

Emerging Theme	Quotes from Focus Group Participants
Principal Investigators Don't Show Interest In Student Media Coverage	**SM 2:2**= "I think that PI's or researchers aren't really concerned if students know about what they're doing because they're primarily focused with getting grants and publishing in scientific journals."
	SM 1:3= "I don't think that they are extremely motivated to reach out especially to the students, or just Penn State public in general. I think they more have their eyes focused on publications in scientific journals."
Principal Investigators Have A Responsibility To Talk To Student Journalists	**SM 3:1**= "They're in a university setting and their main job here is well to research, but also to educate the student body."
	NSM 2:3= "I think that an ideal that we should strive for is for researchers to make their research more publicly known. Because if the researcher's research is actually going to have a big impact on the world, shouldn't the world know about the impact it's having?"
Principal Investigators Could Benefit From Student Media Coverage	**SM 3:1**= "It's important to reach your student body too because they're the ones that supply a lot of the work as undergraduates in labs. So you want to get them interested and excited about [research] too."
	SM 1:2="I think it might make them feel good and that the research they're doing has meaning to more people."
KEY: SM=Science Major & NSM=Non-Science Major; Focus Group #: # Assigned to Participant	

Finally, as shown in Table 6, the science and non-science major focus groups provided their thoughts on science news produced by student journalists. The first theme observed was that focus group participants felt it was very important, although difficult, for student journalists to act as middlemen for science news to help simplify the scientific information. Focus group participant 2:2, a science major, said:

> I think it is possible to put [the science] into layman's terms. It might be a little more difficult for a student, but it's definitely possible. The same way that a doctor can explain a complex surgery to a patient, a student can explain the general basis of what a research lab is doing in an article.

The majority of focus group members believed they could trust the science reporting done by students as noted by participant 2:3, a science major, who said:

> If student journalists can produce quality content that is scientifically sound and makes sense, and teaches the reader something, I think that credibility can be gained.

Lastly, another theme that was seen from the student audience was that they felt it was crucial for student journalists to make the science stories more relatable by stressing its impact on the general population or emphasizing narrative storytelling to explore potential human-interest angles. Focus group participant 2:5, a non-science major, said:

> Just overall making a better effort to make the articles more relatable, make the wording more understandable and keeping it more like a narrative as opposed to like a thesis almost.

Table 6: Student Audience's Thoughts on Efforts of Student Journalists

Emerging Theme	Quotes from Focus Group Participants
Though Difficult, Important For Student Journalists To Act As Middle Men For Simplification	**SM 2:2**= "I think it is possible to put [the science] into layman's terms. It might be a little more difficult for a student, but it's definitely possible. The same way that a doctor can explain a complex surgery to a patient, a student can explain the general basis of what a research lab is doing in an article."
	SM 3:3= "I think it has to be a strong balance. Because when the PI is explaining their work, they're so like invested and involved in this work that even words that they're speaking they think is common English. But to the common reader, like it's not English. So I think sometimes you might have to sacrifice detail for simplicity and that's just like to get the readers."
	NSM 2:5= "An example would be like the science section of any major publication like the New York Times, Time magazine, or specifically Scientific American. They're really hard concepts, but they explain them in a very easy way. So emulating that formula, I think would be really helpful."
Student Journalists Can Be Trusted To Report Science Accurately	**SM 2:3**= "If student journalists can produce quality content that is scientifically sound and makes sense, and teaches the reader something, I think that credibility can be gained."
Student Science Reporting Needs To Make Content More Relatable To General Audience By Focusing On Its Impact and Human-Interest Angles	**NSM 2:5**= "Just overall making a better effort to make the articles more relatable, make the wording more understandable and keeping it more like a narrative as opposed to like a thesis almost."
	NSM 2:8= "I would like to see yeah, the way it relates to liberal arts majors, and how that affects us. Because obviously if you're in science you know, but if you're not then like I have no idea what certain things mean in the grand scheme of things. So if you could relate it to like the arts and to anything that's not science, I'd be interested in the impact it has."
	SM 1:2= "I think if they're titled like in a way that captures people's attention, I think [the audience] will read them…Certain topics are hot topics for like everyone."
	SM 3:3= "I think it would be really cool to like read [about] a research lab that's being highlighted each week—like if they did like a series like that. But, I think the focus really has to be more on [starting with] the people and like their story working in the lab, and incorporate the science. I think that you're going to have trouble like getting people reading on their free time if you're just focusing on the science."
KEY: SM=Science Major & NSM=Non-Science Major; Focus Group #: # Assigned to Participant	

Student Journalists

The final focus group consisted of five student news media journalists—all editors. In the discussion, several themes were found among the statements made by the participants as seen in Tables 7 and 8. Table 7 focuses more on the general news coverage preferences of student journalists. The first theme that was found for journalists in terms of general news was that

student news coverage is driven by what is important to the readers rather than page views. Focus group participant 4:2 said:

> I think there can be a balance. You always need to keep viewership in mind, but you can't let it get in the way of important topics.

One of the reasons for this is because page views don't always show the full picture of the success of a story. Focus group participant 4:1 said:

> I don't really think analytics mostly ever tell the tale of a story…I would say how well a story is done—pretty much just how it's written, how it's received, how you're able to drive those points home.

Additionally, the student journalists generally felt that feature stories were more enjoyable for them to write in comparison to hard news stories, as said by participant 4:3:

> I think there's a difference between like [a story getting] however many page views because of the topic. Like anyone could have written this and it would have gotten the same page views no matter what just because of the content that is in it or like the news value. Versus like [if a story] got a lot of page views because a person did a really good job writing it or got like a really good interview with the person it's about. Things like

that I think are more satisfying because you know it's a result of like the direct work and effort that you put into it…

Table 7: Student Journalists' Thoughts on General Story Coverage

Emerging Theme	Quotes from Focus Group Participants
Coverage Is Goverened By What Is Important To Readers, Not Page Views	**4:1=** "Certain topics I feel warrant coverage because of their importance to the community even if it will not generate a certain number of views."
	4:2= "I think there can be a balance. You always need to keep viewership in mind, but you can't let it get in the way of important topics."
Page Views Don't Equal Success For A Story	**4:1**= "I don't really think analytics mostly ever tell the tale of a story…I would say how well a story is done—pretty much just how it's written, how it's received, how you're able to drive those points home."
	4:3= "Sometimes obviously you could get the page views for the wrong reason and that highest page view could be because a story was really unsuccessful. That's kind of a worst-case scenario, but it does happen. And then I also think that in terms of defining success, it can be maybe only a fraction of the people you thought would read the story read it, but they like engaged with it a lot—it really drove their decision-making or what they did next in a certain process."
Writing Feature Stories Provide More Satisfaction To Student Journalists Than Writing Hard News	**4:1**= "Personally, I always like the features because there is a very sole connection to that. It's not just some sort of cookie cutter thing that a news story might be."
	4:3= "I think there's a difference between like [a story getting] however many page views because of the topic. Like anyone could have written this and it would have gotten the same page views no matter what just because of the content that is in it or like the news value. Versus like [if a story] got a lot of page views because a person did a really good job writing it or got like a really good interview with the person it's about.' Things like that I think are more satisfying because you know it's a result of like the direct work and effort that you put into it…"
Key: Focus Group #: # Assigned to Participant	

Table 8 provides some emerging themes regarding student journalists' perceptions of their science news production. The first theme seen among the participants was that again, the journalists felt their responsibility was to cover what was deemed important, not specifically science stories. Participant 4:2 said:

> I think we have a responsibility to cover important topics in general, not just those based in the sciences.

Another theme that was observed among the editors was that their lack of understanding about science did dissuade them from covering science more, leading to less overall coverage. Focus group participant 4:4 said:

> A lot of the technical jargon makes it difficult to report on, understand and see real-world application.

The journalists also believed the lack of communication from both sides—their own and on the part of the scientists too, have been a part of the issue in their science coverage. Focus group participant 4:3 said:

> From my perspective I don't know exactly how the whole strategic [communications] works for the research side of Penn State, but from what I've seen coverage-wise, I think they reach out a lot more to like national outlets…But I don't think that they reach out a lot to not only us, but to any local outlets. And maybe they don't see the value in that. I think it depends what their goals are. And for us I think it's hard to figure out who to reach out to, even if we would want to reach out…

Although there was a lack of consensus on whether the editors report on science adequately, all of the editors said that they could do more in terms of science coverage. Part of the problem according to participant 4:3 is that not enough science stories are being pitched during meetings for editors to decide to cover the labs more. In saying this, one of the things that the journalists believe they can improve upon is being more in tune with the scientific research labs on campus. Focus group participant 4:4 said:

> I think we should be more engaged with the research going on here—just know what kind of findings are coming out and then reporting on it in a way that's relevant and engaging to our readers. I think an important part of science journalism is showing why something is important and relevant…I think people get more out of learning how something applies to them in like language that they can understand and I don't think that's something we do a lot of now.

But in addition to this, adding a more human-interest aspect to the science stories, along with focusing on the impact the research has on people could really help improve science coverage according to the student journalists. Participant 4:3 said:

> Kind of framing it more like the impact that it is having on like real people who are affected by whatever the research deals with [could be more effective]. Or like I think it would be more effective to go through the researcher if they similarly have some sort of personal story about why they got into that type of research. I

don't necessarily think every researcher like has a hook, but for the ones that do, I do think it's more effective than sort of just like a hard science story.

Table 8: Student Journalists Discuss Their Science Coverage

Emerging Theme	Quotes from Focus Group Participants
Journalists Feel Responsibility To Cover Important Topics, Not Specifically Science	**4:2** = "I think we have a responsibility to cover important topics in general, not just those based in the sciences."
	4:4 = "When the topic is relevant in an important way, yes [we need to cover science]…Other topics are at our discretion of what we think would be interesting."
Their Own Lack Of Understanding Does Hold Science Coverage Back	**4:1** = "[Lack of understanding] is a major issue, which is why making stoies more relatable to something in everyday life of your average person is important."
	4:4 = "Yes--a lot of the technical jargon make it difficult to report on, understand and see real-world application."
	4:2 = "That is the basis of the challenge. Because if you have like a scientist or any professional in any sort of field that's very experienced in something, they might get frustrated talking to just a regular person…So if anything there's sort of a difficulty in almost like translating I guess the complexities of that field into again layman's terms and helping just the regular person get some sort of understanding."
There's A Lack of Communication On Both Sides Of The Aisle For Science Coverage	**4:3** = "From my perspective I don't know exactly how the whole strategic [communications] works for the research side of Penn State, but from what I've seen coverage-wise, I think they reach out a lot more to like national outlets…But I don't think that they reach out a lot to not only us, but to any local outlets. And maybe they don't see the value in that. I think it depends what their goals are. And for us I think it's hard to figure out who to reach out to, even if we would want to reach out…"
Work To Be Done In Being More Engaged With Research Labs On Campus	**4:5** = "I think that one thing that could improve our science coverage, although we have ventured into this recently, would be to kind of highlight to a greater extent than we already do some of the work that goes on within labs here, or that Penn State students or faculty researchers are conducting. That would be relevant to kind of our mission as a website and at the same time are happening here."
	4:4 = "I think we should be more engaged with the research going on here—just know what kind of findings are coming out and then reporting on it in a way that's relevant and engaging to our readers. I think an important part of science journalism is showing why something is important and relevant…I think people get more out of learning how something applies to them in like language that they can understand and I don't think that's something we do a lot of now."
Focus On Human Interest And Impact Would Help Science Coverage	**4:2** = "I feel like it can help because if you're trying to explain to somebody about some sort of a topic or some sort of research that they might not understand regularly and you put it through the lens of the person doing the research and you kind of see it through their eyes, I feel like everyone can understand people but not everyone can understand the science. But if you put the science through the lens of the people that are doing the research, it might help [the audience] get some sort of an understanding."
	4:3 = "Kind of framing it more like the impact that it is having on like real people who are affected by whatever the research deals with [could be more effective]. Or like I think it would be more effective to go through the researcher if they similarly have some sort of personal story about why they got into that type of research. I don't necessarily think every researcher like has a hook, but for the ones that do, I do think it's more effective than sort of just like a hard science story."
Key: Focus Group #: # Assigned to Participant	

Chapter 5

Discussion

Previous research has been done on the communication of science through journalism, but less is known about the dynamics operating student media and university research news. The goal of this study was to explore the perceptions of student media coverage of science among scientists, student journalists, and the student audience. The study asked three major questions: How principal investigators of research laboratories and the student journalists communicate to develop science coverage? How do or could student journalists bring more attention to their news coverage on important scientific research being conducted on campus? Which types of stories are more interesting, understandable and engaging to audiences, and why?

The Need for More Interaction among Scientists and Student Journalists

From the focus group discussion with the student journalists, there was a consensus that although they didn't have the responsibility to cover science, they did have the responsibility to cover what was interesting to their readers. There is no science beat for either outlet, but both outlets do have reporters dedicated to campus life news for this purpose. But in saying this, the journalists first need to know when interesting events are happening—in this case within the scientific research laboratories at the university. One interesting note to come out of the focus group discussion with the student media editors was that not very many staff members pitch ideas regarding scientific research. They say this is a major reason there isn't as much coverage as there could be. And as they said during their focus group, the student journalists need to

become more aware of those things by being more engaged with the research labs on campus and the work they do. If the editors assigned reporters to specifically keep up with any potential newsworthy events in the scientific research community, this could allow them to have a better grasp of the interesting scientific developments at the university.

Previous literature indicated that researchers are perceived as part of the reason for a lack of communication of science as well, though (Funk et al., 2017). Focus group participant 2:2, a science major, noted that he's seen a student journalist get turned down by a principal investigator for a potential story before. The principal investigators sampled for this study acknowledged their role in this deficit of communication. They are more comfortable going through institutional strategic communication channels than contacting student journalists, despite knowing that more of the university audience reads the student media outlets. In fact, they said they don't even read the student media outlets. The student journalists also believed this was a two-way street as the lack of contact from the researchers has them unsure how the communication of science works for the researchers or even if they are interested in the more local coverage. So, in order for a relationship to be developed between student journalists and principal investigators, the researchers need to take initiative as well. First, they need to become more in tune with student news around campus by finding time to read the outlets and they also need to understand that the majority of their audience at the university—the students—reads the student media outlets.

But according to the science majors who work in labs under a principal investigator, educating the students about their work is not the primary focus of researchers. This is because they are focused on publishing scientific journal articles and pursuing grants for their work. However, science majors felt they have a duty to educate the students at the university about

their research. One potential benefit according to a focus group participant was that if they communicated more to the student public, this could generate more interest in their laboratory and lead to more science students wanting to work in their labs.

A past study showed that university scientists are trusted more than scientists working for the private sector (Critchley, 2008). The investigators that were interviewed said public funding means a responsibility to communicate their science to the public. The scientists now just need to realize that their most immediate audience—the students—matter too. Using the student media outlets as a channel of communication for their work is crucial for the students to read and learn about it.

Trust Needs To Be Established Between the Two Sides

Previous research indicated that an issue between researchers and journalists is that scientists don't like the "risk of incorrect quotation" and the "unpredictability of journalists" (Peters et al., 2008, p. 204). Although the principal investigators never said they don't trust the student journalists, they said they do question if the journalist will interpret the science incorrectly and publish an inaccurate story because of it. In order to combat this potential issue, the suggestion was made by one of the researchers for the journalists to run the science within a story by them before publishing the article. Researchers need to understand, however, that journalism is not the same as public relations. So this would cause hesitation on the part of journalists because of the thought that this might go directly against journalistic standards. Professional science journalists interviewed said, however, in order to ensure accuracy, they have used this method in a limited fashion. One professional science journalist felt that asking

principal investigators about a paragraph or two within a story was an example of how to best assure accuracy. This seems like a potential way that the principal investigators and the journalists could build trust and ensure accuracy. Although the researchers should never expect a journalist to ask for permission to publish a story, they should learn how to better work with journalists to accurately portray the science.

Lack of Understanding Science Should Not Impede Coverage

Ultimately, both the journalist and principal investigator want to report on the science accurately. The ability to ensure accuracy is tough for student journalists and particularly hard if they don't understand the scientific material that they are reporting on. And this is the case a lot of the time because student journalists are not often science majors. A common theme in the student journalist focus group was that a lack of understanding of the science topics on their part does hold their science overage back. One of the professional science journalists, who covers a science beat, saw being a novice in science as beneficial for conveying the science to a similarly non-scientific general audience. In order to help ease this issue, the professional journalists urged the student journalists to ask questions and act like they know nothing when interviewing researchers. This is good advice because this forces the scientific researchers make the science sound as simple, yet accurate, as possible for the journalists. The student audience focus groups also said they trust student journalists to write about science despite their lack of expertise, saying that as long as their content is sound, that's all that matters to them. The student audience participants said in the focus groups that they are counting on the journalists to act as middlemen and bring the science coverage forward in a more understandable way. This responsibility as a

conduit for scientific information is important and previous research says so as well (Fahy & Nisbet, 2011). Even the principal investigators realized the importance of student journalists in conveying scientific information that they may not be able to convey in a simple enough manner. One investigator urged the student journalists to spend time observing their lab first and then report on it in order to help the journalist feel more comfortable with the science. So as principal investigators start realizing the value that these journalists have in sharing their work with the public, the journalists also need to make the effort on their own end to bring the science to the public eye despite a lack of understanding. Because, in fact, their lack of science expertise can be an asset in bringing understanding to science topics for a general audience. The two sides need to use their common interests in accuracy and reader engagement to build the foundation for a relationship able to improve science communication at universities.

Maximizing Attention toward Science Coverage

Focus group participants within the study noted that they don't actively seek out science news, but would read it if they saw it. This was consistent with previous research that said that only 17 percent of American adults actively seek out science news and 68 percent of American adults get their science news because they "happen to come across it" (Funk et al., 2017, p. 16). And while the majority of focus group participants said they didn't see much science coverage around campus, a common opinion was that they were interested in seeing more. This was again consistent with previous research, which indicated that 52 percent of American adults enjoy hearing about science than other topics in the news (Funk et al., 2017). The consensus among focus group participants was not surprising because they are in the college environment. With

everyone being so busy with their own activities, the time to sit down and search for news articles is virtually nonexistent. That is why student journalists need to capitalize on the moments when students are checking social media on their phones.

Focus group participants agreed that the use of social media is an important way to share with the public. Previous literature cited that though social media is unreliable, over half of its users still click on the links within the social media science posts (Funk et al., 2017). And participants said that although social media could be untrustworthy sometimes, because these student media outlets are very familiar to the student audience and are staffed by students, they would be more likely to trust those writing the stories found on social media. This new social media age also provides for the opportunity of more accountability from those who are reporting the science according to one of the principal investigators, who said that the ability for people to immediately respond to posts is important. As previous research has said, this really increases transparency and dialogue with science news consumers (Allan, 2011). Additionally, this aspect of social media highlights the "participatory, social and collaborative" nature of digital news that is referenced in previous literature (Purcell et al., 2010). So not only is social media effective because that is where the target audience of the science news is, but also because it allows for more active engagement with the content. One of the principal investigators even noted that they check Twitter every day for science news.

It seems that the key to exposing more readers to science stories and getting more engagement for the stories is to push out science stories through social media channels more than what is currently being done. Several focus group participants said they have never seen science journalism on campus and that the only place they really go to potentially get news is social media. Without pushing the science content on social media, the student public likely won't see

it. That's why it's crucial to do this in order to take advantage of the potential for accidental exposure to the stories. And when posting on social media, not only should the accompanying caption be interesting, but the headline of the story should captivate potential readers. Focus group participants stressed the importance of needing to draw their interest through the headline to get them to click on the story. By capitalizing on the popularity of social media throughout a university environment and drawing readers in through a catchy headline, it could improve readership for science stories.

Visuals, Depth of Reporting and Science Topic All Matter to University Audience

One theme that was found through the student audience focus groups and the content analysis was that visuals were important. In the content analysis, of the top five most viewed stories from both news sites, nine of them contained a visual related to the science discipline being discussed. Additionally, one of the talking points of the focus group discussion was that the video that was presented to the groups was marginally effective to not effective at all because there was not enough time in a two-minute video to explain the complexities of the science. However, there was a consensus that having a visual that explained some of the science and was easy to digest would be helpful. Some of the participants particularly noted that infographics could be useful. This was a theme that made sense because some readers are visual learners. By giving the audience something else besides the actual writing, the audience has something else to look at and become interested in, whether that be about the science or about the people doing the science.

Depth of reporting also played a role in keeping readers engaged in a story. Focus group participants noticed that not only were more sources quoted in article two, but also that more of a variety of sources were used. The student audience felt that this depth of reporting and the better writing found in article two made it a more quality article, despite making it a longer article. The Daily Collegian's articles contained more sources used and more variety in those sources as well. The outlet's average time on page could have been higher as a result. Depth of reporting is valuable because it allows a science story to be discussed using a variety of voices, which can help facilitate learning.

The scientific topics being discussed also greatly matter. For example, a science major in one of the focus groups solely didn't like article two as much as article one because the content in article two was less interesting to them. Previous literature also supports the idea that certain scientific topics not only garner more coverage, but also more interest from news consumers. A past study showed that medicine and biology dominated science coverage worldwide (Bucchi & Mazzolini, 2003; Artz & Wormer, 2011). This trend was also noticed at the university level in the content analysis, as the two top science topics covered in science stories were biology and medicine. And consumers are especially interested in medical topics. Health/medicine is the science discipline that seems to garner the most interest among U.S. adults, as 28 percent of U.S. adults say they are most interested in it, while 70 percent say they are interested in it (Funk et al., 2017). Medicine and biology were also represented well in the top five most viewed stories on each student media outlet. Five of those 10 stories were focused on those two topics alone. So because consumers are interested in science that relates to them, medicine was a hot topic in scientific research. Medical research carries the connotation that it's important because it could potentially cure a disease or provide treatment to those who are injured. Chemistry was found to

have a negative interest rating in a previous study (Badenschier & Wormer, 2011). None of the science stories sampled here focused on chemistry. The importance of a relatable science topic for the student audience cannot be understated—two of the most viewed stories from the student media outlets were about medical marijuana. With this being said, journalists should aim to focus their coverage on topics that can impact the student audience. Medical research is an example of that, but it can be seen in other cases as well, like food science or technology. When people feel the impact research of a specific scientific discipline can have on them, they are more likely to want to read about it.

Human-Interest Angle Is Vital In Student Science Coverage

Both the student audience and student journalist focus groups believed that above all, the human-interest angle was the most important aspect of science coverage being interesting and impactful—a finding supported by other research (Gutsche et al., 2017). The reason that this is the case is because as noted by both of the professional science journalists, it gives the readers a way into the story because at their core, humans relate to other humans. In the focus groups, all participants gravitated toward the article emphasizing narrative storytelling about the principal investigator, although not all preferred the story. The reason why it was an effective mechanism to talk about science was because it increased interest in the story, and because of that, kept the readers engaged in the content despite the complexity of the science. This opened the doors for learning about the science. This was supported by the focus group participants' responses and is consistent with previous research. A study done by (Opgenhaffen, 2011) said that online features were particularly helpful for when the content was harder to understand.

The Daily Collegian wrote more science feature articles than it did hard news. These features were found to focus more on the people, rather than a timely event or discovery. In contrast, more of Onward State's science stories were hard news. This is why the split between the average time spent on each news site's stories made sense. By the Daily Collegian adding more human-interest aspects to its stories, with more interviews and more perspectives, it allowed people to stay engaged in the content. This correlated with people reading its science stories over a minute longer than Onward State's science stories. The newspaper's science stories even beat its general stories for average time on page. This shows that there is certainly interest in these science stories, and by bringing more of people's voices into the stories and allowing people to relate to other people, it helps readers stay engaged in the science content.

Student journalists said that they enjoy writing feature articles more and so by producing more of these science features, perhaps they could become more interested in writing about the science themselves. They also noted, however, that feature articles don't necessarily get the same number of page views as hard news articles—consistent with previous research done by (Singer, 2011). The editors said that page views don't tell the entire tale of the success of a story though, and that they have a minimal effect on deciding their news coverage. This was in contrast to previous research done by (Welbers et al., 2016). Since the editors decide coverage based on what is interesting to the readers, it would make sense to frame science articles to have more of a human-interest focus because as the focus participants noted, this makes the articles more interesting and therefore more engaging for them.

One of the principal investigators even emphasized the need to do this because they believed that by getting to know the people behind the research first, the journalist could write a better story on the science as a result. In order to help student journalists do this, they encouraged

the journalists to observe the people in the laboratory and get to know their story. Hearing this from the principal investigator was encouraging because it shows that they understand that because of how complex science is, journalists need to find ways to bring it down to a more basic level. By adding in the human-interest angle, whether by showing impact on other people or by narrative storytelling of the people behind the research, this goal can be accomplished.

Chapter 6

Conclusions

The goal of this study was to develop a deeper understanding of the influences on student media production of science news, and how to better communicate science through student media channels. It did this through quantitative and qualitative methods, and assessed the issue of science communication from the angle of the student audience, the principal investigators and the student journalists.

The first research question asked how principal investigators and student journalists communicated about scientific research. The study found that there was almost no line of communication between the two researchers and the student journalists surveyed here. And according to their responses, in order to combat this issue, a number of steps need to be taken. First, the researchers need to start reading the student media outlets more to understand the coverage and the journalism. Student journalists also need to start looking in the right places for potential stories about important scientific research endeavors. Since the principal investigators go through institutional communication methods to post about their findings, the student journalists should regularly be monitoring places like departmental websites in order to see if there is any interesting potential science content out there and pitch those ideas in meetings. It's imperative that student journalists make this effort because as one principal investigator noted, there's a lot of research discoveries happening around the university and the researchers cannot go to the student media outlets for each and every finding they make. But before writing a story about science, the journalist should do a little homework to get the background knowledge

needed to talk to the researchers. Both student journalist/focus group participant 4:5 and PI #2 believed this was necessary. In conjunction with this, the principal investigators need to trust that the student journalists will do their job as best as they possibly can. One potential way to do this is to confirm the scientific accuracy of stories with the researchers before publishing the article. The principal investigators support this and professional science journalists have done this before as well. However, the student journalist should be the only one to initiate this conversation; the researcher should never expect this to happen. Finally, both sides need to realize that they both value the same ideals. Both the principal investigators and the student journalists say that accuracy comes first and foremost, but it's important for the stories to be interesting and engaging as well. When both sides start to show an interest in taking these steps, the foundation for a relationship between principal investigators and student journalists can be built, leading to better science communication at universities.

Secondly, the study examined perceptions of student science news, and preferences for content, format and style. One of the student journalist focus group participants noted why this is an important question to ask: The people who are interested in science are only a small fraction of all those who read the outlet's website. However, the majority of student audience focus group participants said that they would be interested in seeing more science news. They also said that their main, if not only, source of campus news comes through social media. This is why utilizing social media to promote these science stories is so crucial to increasing the viewership of the articles. PI #2 noted in their interview that they often just surf Twitter to see if anything of interest comes up on it. Additionally, as previous literature showed and as was observed in the student audience focus groups, many readers don't actively search for science news. However, they said that they would read it if they came across it. Social media is a place where this can

happen, and could therefore be the key to expanding science readership on the student media outlets' websites. Though there are concerns about potential inaccuracies that occur on social media, even PI #2 said that the ability for an immediate response on social media keeps the people who are posting scientific information accountable. Additionally, a focus group participant noted that since the students know who the Daily Collegian and Onward State are, that would lead them to trust the information the outlets are providing more than if it was a random source posting on social media. So in order to increase the readership of the science stories, student news outlets should really be pushing them on social media so that more people can 'happen to come across them.'

Finally, not only are developing relationships between researchers and journalists and having a formula to effectively promote science stories important, but also finding a way to make the stories as engaging as possible. Both the student journalists and the student audience agreed that the way to keep readers as engaged as possible is by making the stories relatable to them. This is often done through human-interest or feature stories. The focus groups demonstrated that the student audience preferred articles that had a captivating lede, were written better with more depth to their reporting, contained a related visual element, emphasized a human-interest angle and allowed them to learn more. Particularly, the audience gravitated towards the article presented to them that although was longer, had better depth to its reporting in terms of sources and was a feature article. The content analysis also showed that the Daily Collegian, which had better depth to its reporting and more science features, had a much higher average time on page for its science stories than Onward State, even surpassing its own average time on page for its general stories. The article presented to the student audience focus groups used narrative storytelling to bring the human-interest angle to the story, and although the audience said this

was effective, the participants also noted that the best possible way to draw them in as readers was to show the impact it not only had on them, but also the general population. Though it did not always lead to understanding, bringing this relevance on a human level was crucial in getting the reading audience interested in the science topic and thus keeping them engaged throughout the story.

The study also had some limitations. The focus groups were small, with only 19 participants total. Additionally, only two principal investigators and two professional science journalists were interviewed. The content analysis sample was relatively small as well. A study with a larger reach could provide more data and understanding. Future research includes exploring which analytics student journalists use to determine successful engagement for a story. Page views and average time on page never really correlated with each other in this study for the content analysis and so learning which analytics student journalists value most would be interesting. Additionally, another angle that is intriguing regarding science communication at the university level could be the point of view of university administration. Talking to administrators about this issue would be helpful in understanding how they regularly help principal investigators bring their work to the public eye. It would be interesting to see what they feel effective science communication looks like, how they view student media and professional news coverage of science and understand their strategies for the promotion of scientific research conducted at the university.

To close, by bringing a human focus to science stories—either through demonstrating its impact on general people or by narrative storytelling about the people doing the research—readers not only gain interest in the science topic, but also stay engaged throughout the course of the story. As focus group participant 1:2 said:

> I think there's an opportunity for people to be interested in these [science] articles and for the journalists' side, people need to find a way to make those articles interesting and relevant.

Focus group participant 3:3 also noted that a large research institution is in a unique position to have a lot of science coverage:

> I think Penn State is very unique in that sense. Penn State is one of the few schools that literally thrives on this research. That is a huge part of what Penn State is. So just to kind of emphasize that more and get those people's names and work out there I think would be really cool.

In agreement, focus group participant 2:3 believed that university scientific research deserves to be promoted more, and said that student journalists are the key to making this happen:

> Penn State has a lot of world-class research that isn't matched anywhere else. And I think student journalists could be the torchbearers for this really high-class research that's only going on at Penn State…Journalism is the conduit that can make scientific terms more relevant to just the average general reader.

Appendix A

Code Sheet Used for Content Analysis

Unit of analysis is online student news articles on both Onward State and The Daily Collegian.

Directions: Please code each article for the following. Use your best judgment.

1. Article ID

2. Date of Story [INSERT DATE]

3. Number of words in article [INSERT WORD COUNT]

4. Student Media Outlet:
[1] Onward State [2] The Daily Collegian

5. Number of Page Views [INSERT NUMBER OF PAGE VIEWS]

6. Number of People Quoted:
[0]
[1]
[2]
[3]
[4] or more

7. Who is quoted?
[0] None
[1] Faculty associated with particular research project
[2] Graduate Students
[3] Undergraduate Students
[4] Faculty not associated with particular research project
[5] Administration
[6] Community member
[7] Other
[8] Two different categories
[9] Three or more different categories

8. Type of Story--News, Opinion, or Feature Piece: [Read through the article and determine the type of article]
[1] Hard news
[2] Opinion
[3] Feature
[4] Other

9. Story Topic:
[1] Science
[2] Sports
[3] Student Life
[4] Entertainment
[5] Campus
[6] Other

10. For science-related stories only:
Is this a story that talks about research/laboratories/scientific discovery?
[0] No
[1] Yes

11. For research stories only: What science subject did the research lab focus on?
[0] None
[1] Biology
[2] Medicine
[3] Physics
[4] Chemistry
[5] Astronomy
[6] Earth Sciences (geography, meteorology, atmospheric science, geology)
[7] Climate change
[8] Sustainability
[9] Social sciences
[10] Engineering
[11] Agriculture
[12] Energy
[13] Technology
[14] Mathematics
[15] Food Science
[16] Other
[17] More than one

12. Is the lede centered on *a* person?
[0] No
[1] Yes

13. Does the story contain story-related visual elements?
[0] No
[1] Yes

Appendix B

Principal Investigator Interview Questions

Potential Interview Questions:

Penn State Researchers

1. Do you think that there are enough stories written about scientific topics/research labs on campus?
2. Why or why not?
3. Do you believe that a lack of understanding holds the media back from covering scientific topics more?
4. Do you believe that you have a responsibility to share your interesting findings and research?
5. What are the best ways that you can stay active with the media and help spread scientific information better around campus?
6. Do you use social media at all for your research? Why or why not?
7. How can journalists best work with you to cover the scientific topics that you research?
8. Do you believe that journalism is a useful way to spread your scientific research around campus?
9. If a journalist approached you to write a story on your team's research, what would your response be and why?

Appendix C

Professional Science Journalist Interview Questions

Potential Interview Questions:

Professional Journalists

1. What do you think the best way to cover scientific topics is?
2. What is the most difficult thing about covering scientific topics as a journalist?
3. Do you believe journalists need to know about the science they are writing about in order to write a good story?
4. What are the limitations in the journalism industry to writing more science stories?
5. Do you believe there is a smaller audience who will read science stories? And if so, is that what holds back more coverage of these topics?
6. How do you weigh the need for certain news coverage vs. views?
7. Do you believe some of the burden to cover these science stories falls on the willingness of scientists/researchers themselves?
8. Do journalists have a responsibility to cover these tough scientific topics?
9. What would your biggest advice be to student journalists attempting to cover these tough scientific topics?

Appendix D

Article 1 for Student Audience Focus Groups

Penn State Researchers Are Revolutionizing Solar Panels

High-efficiency solar panels will be coming to a rooftop near you soon, and it's all thanks to Penn State research. Referred to as concentrating photovoltaic — or CPV — systems, these solar panels operate a much higher efficiency than the standard solar panel.

Until recently, CPVs only existed on a large scale, typically in systems that are about the size of a billboard. Chris Giebink, an assistant professor of electrical engineering at Penn State, has put in work to shrink those down to a more reasonable size for application on a residential level.

"Most solar panels that you see on people's roofs are made out of silicon or other materials that are about 20 percent efficient. That means that they convert about one-fifth of the sunlight's energy into electric power," Giebink said. "You see them everywhere and they work well and their price has decreased dramatically, but more and more there's a challenge to increase the efficiency and get something substantially higher than that 20 percent."

That challenge is one that was taken on by a research team that included Penn State and University of Illinois engineers. They were able to vastly decrease the size and manufacturing cost of creating these ultra-efficient solar cells. CPVs concentrate sunlight anywhere from 100 to 1,000 times and they can operate at nearly 50 percent high efficiency than the standard solar panel.

"If you stuck one of these up on your roof and compared it with the state-of-the-art solar panels already out there, you could get 30 to 50 percent more energy over the course of a typical, sunny day," Giebink said.

While the panels have previously only been implemented in large open areas, like deserts in California, Arizona, and Israel, this project has solved the size issue.

Conventional solar cells for CPVs are a centimeter, while the new cells created through this research are just a few hundred microns — or a few tenths of a millimeter — in size.

In addition to removing size concerns, Penn State engineers have been able to lower the production cost of CPVs by altering the optic technology that tracks the sun. The standard CPV uses a lens that has to tilt throughout the day, adjusting itself to precisely concentrate sunlight on the solar cells.

Now, the cells themselves shift just a centimeter in any direction to follow a focal spot of sunlight. The optics are cheaper, and so are the cells themselves due to advances in their creation process.

“The end result is a CPV panel that achieves a full day’s worth of tracking just by sliding a tiny amount, and from a distance, you can’t tell that they’re moving,” Giebink said. “For all intents and purposes, they behave very similarly to a standard solar panel that somebody puts on their roof.”

Don’t rush to the store to purchase the latest in solar panel technology just yet, though. Giebink said that there is no set timetable for a smaller CPV to hit the market, but he’s optimistic about the getting the panels down to a low price point.

“It’s tough to speculate on cost, because we’re mainly involved in the science, but what I can say is that it has the ingredients to give a low-cost power system,” he said.

Appendix E

Article 2 for Student Audience Focus Groups

Girirajan Lab Seeks To Bridge The Gap Between Fly And Human Genomes

Six hours and 15 minutes: That's roughly how long a flight from Seattle to State College is. For Dr. Santhosh Girirajan, that was not only a long flight, but also a career-changing one.

It was on this flight that Girirajan read a book that a colleague urged him to read called *Time, Love, Memory* by Jonathan Weiner. Girirajan was on his way to Penn State to research mice after completing his postdoctoral training at the University of Washington. This book, however, convinced him of the importance of fruit flies as it explored how famous scientist Seymour Benzer founded his career in molecular biology — highlighting Drosophila as an important model organism.

In 2012, when Girirajan arrived in State College following that flight, he had decided that he would research fruit flies in his lab at Penn State after being inspired by Benzer's journey.

"[It's] something that I had not really worked with in the past, and this was something which was very, very new for me. [But] I was thinking maybe if I could use a very conserved and basic model system to really test for cellular and neurological phenotypes then that would be fruit flies," Girirajan said.

The Girirajan Laboratory studies how changes in the genome contribute to common neurodevelopmental disorders such as autism and intellectual disability. The lab uses

both Drosophila (fruit flies) and human cell lines to understand the risks caused by genetic mutations and to grasp how gene disruption leads to altered neurodevelopment.

Girirajan and his team are looking into the effects of an autism-associated 16p11.2 deletion in the genome. A recently published study by the lab, titled “Pervasive epistasis modulates neurodevelopmental defects of the autism-associated 16p11.2 deletion,” investigates the interactions between the genes within this specific region of the genome.

The original goal of this study was to identify which of the genes in the 16p11.2 region, a particular area in the genome that has been linked to autism in previous studies, were important in causing these neurodevelopmental problems. Although the team found that all of the genes showed some level of effect when they were disrupted, together their effect was even greater. Matthew Jensen, a graduate student in the lab, detailed the discovery.

“We saw that many different combinations of genes actually cause a less severe phenotype than each individual gene independently on its own. So that’s a type of interaction we call epistatic interaction, when the effects of two genes are not equal to the effects of each gene on its own added together,” Jensen said. “So that explained the deletion a bit more and that also explained why on a human end we see a lot of what we call phenotypic heterogeneity, so meaning that people with the same deletion have very different clinical features.”

To maximize efficiency and maintain relevance to the human species, the Girirajan Laboratory uses Drosophila. Fruit flies allow the lab to have high throughput because their shorter life cycles allow for quicker results. Additionally, the flies share about 60 percent of their genome with that of humans, which provides the opportunity for serious comparison with human abnormalities.

Dhruba Mayanglambam, the lab’s former postdoctoral scholar, added that Drosophila is a very versatile model organism.

“Another important thing we can do with Drosophila is that we can express or down-regulate the gene of interest in the various tissues. So you can do it in a tissue-specific manner,” Mayanglambam said. “We mostly did our study using the Drosophila eye and nervous system and one important thing about using Drosophila eye is that the phenotype can be easily identified. You can just look at the microscope and can see the phenotype.”

The flies are observed through a plethora of methods, but one particularly useful method is called Flynotyper.

The lab developed the Flynotyper technology to help detect the changes and disorder among the “ommatidial cells” of fly eyes. These ommatidial cells are simply hexagonally-organized structures within the fly eye. The Flynotyper tool allowed the research team to quantify changes to these organized eye structure phenotypes with a “Flynotyper score.”

To understand the effect of the interaction between different genes in the 16p11.2 region of the genome, researchers used one- and two-hit knockdowns, or gene silencers.

For a one-hit knockdown, a single gene would be silenced, while for a two-hit knockdown multiple genes would be silenced together. The two-hit knockdowns were used to compare back to the one-hit knockdowns to see if the increased number of changes in the genome caused for more severe phenotypes. This is known as epistasis.

With a preliminary study like this one, the researchers knew they needed to be clear about how the fly research could be applied to humans.

Cell proliferation is one trait that is examined in the eyes of the flies because it’s linked in several studies to autism defects. The lab isn’t trying to prove that flies with cellular proliferation have autism. Rather, it claims that the cellular defects observed in the flies could be seen in humans too.

A related, more recent study from one of the lab’s graduate students, Lucilla Pizzo, explores gene interactions with the same 16p11.2 deletion on a human level. Pizzo says

that the laboratory thinks of the 16p11.2 deletion as a “proof of principle” that certain genetic alterations can cause multiple phenotypes.

“Probands — or the affected [children] — have a higher burden, or a higher number of mutations, affecting genes that are considered to be intolerant to mutations compared to their parents, and that is probably what is modifying the clinical manifestations of 16p11.2 deletion,” Pizzo said. “So basically if a child has the 16p11.2 deletion and has a higher burden of these other rare variants [the secondary mutations], it is more likely to have cognitive deficits [in contrast to having just the 16p11.2 deletion].”

Pizzo said her research aims to demonstrate that when it comes to clinical diagnoses, there is often much more than meets the eye.

“Even when we identify a genetic mutation that we believe is diagnostic, right now, with the power of technology that we have we should take advantage of that and look further into the genetic background to try and interpret how other rare variants could be modulating the phenotype [to give a proper diagnosis],” Pizzo said.

Jensen agrees with Pizzo, as he believes that the lab’s fly study aptly demonstrates the complexity of the human genome as well.

“You can never really just look at one single gene and say this is the causative gene for all the patient symptoms. You have to look at all the genes in the region and on a human end, all of the variants in the genetic background together, and how they influence the various complex disease phenotypes we see,” Jensen said. “It’s not definitive, but I think it’s exciting because I think people haven’t been asking these questions before.”

Girirajan, a former physician, believes his team is doing its best to help bridge the gap between the human and fly genomes, in order to eventually apply the findings in a clinical setting.

“There is no real convergence between human and fly work. However, we are trying to see if we could fill the gap in between human and fly work by adding more validations

and adding more sophisticated systems that will actually bring back the relevance to humans...” Giririajan said. “Ultimately the idea is to identify pathways, groups of genes, and their networks, and how we can identify potential therapeutic targets that we can use to treat children with these neurodevelopmental disorders.”

Jensen has a genuine interest in the neurodevelopmental topics he studies, and also understands why the laboratory research he does is so important.

“What’s actually really interesting about things like autism and schizophrenia is that there’s still a lot of uncertainty out there. Definitions are changing for the diseases; some researchers will think that autism and intellectual disability are the same disease, kind of like two sides of the same coin. And the biological mechanisms haven’t yet been established. So in some regards we are way behind cancer,” Jensen said. “At first that kind of scared me a bit, but now it’s really interesting to look at the complexity and to try to actually figure out [the science behind it].”

Appendix F

Science Major Focus Group Questions

Penn State Scientific Communication Post-Activity Worksheet

(Science Majors)

This worksheet is being distributed as part of a Schreyer Honors College thesis project. The questionnaire worksheet aims to determine the perception regarding student-produced scientific communication methods.

1. What is your current major?
2. Do you currently participate in a research laboratory on campus?
3. If so, why did you join the research laboratory?
4. Do you talk about science-related topics on a daily basis at home with your family/friends?
5. Which article did you prefer—Article 1 or 2?
6. Why did you prefer that article?
7. Which story better allowed you to understand the science? And why?
8. Do you believe that college research laboratories are important? Why or why not?
9. Do you believe research laboratories on campus are interesting? Why or why not?
10. Did the video component help add to your understanding of the scientific topic?
11. Do you read scientific communication stories at all?

12. Why or why not?

13. Do you see a lot of scientific communication articles around campus?

14. What would make you want to read scientific articles more?

15. What is your favorite type of news article to read around campus and why?

16. Do you believe that you enhanced your educational experience as a college student by becoming part of a research laboratory?

Appendix G

Non-Science Major Focus Group Questions

Penn State Scientific Communication Post-Activity Worksheet
(Non-Science Majors)

This worksheet is being distributed as part of a Schreyer Honors College thesis project. The questionnaire worksheet aims to determine the perception regarding student-produced scientific communication methods.

1. What is your current major?

2. Which story did you prefer to read—Article 1 or 2?

3. Why did you prefer to read that story?

4. Which story allowed you to better understand the science? And why?

5. Did the video component help add to your understanding of the scientific topic?

6. Do you read scientific communication stories at all?

7. Why or why not?

8. Despite not being a science major, do you have an interest in science-related topics?

9. Do you see a lot of scientific communication articles around campus?

10. What would make you want to read scientific articles more?

11. What is your favorite type of news article to read around campus and why?

Appendix H

Student Journalist Focus Group Questions

Focus Group Post-Activity Worksheet
(Penn State Student Journalists)

This worksheet is being distributed as part of a Schreyer Honors College thesis project. The questionnaire worksheet aims to determine the perception regarding student-produced scientific communication methods.

1. How do you weigh coverage of certain topics against the need to attain a certain number of views?

2. Do you believe that your publication/news organization sufficiently covers the scientific community at Penn State?

3. Why or why not?

4. Do you believe you could do more to cover scientific topics at Penn State?

5. In what ways could you improve your coverage of scientific topics around campus?

6. Does a lack of understanding regarding science topics hold back science coverage?

7. How often do you read scientific stories throughout the journalism industry?

8. What types of coverage/stories do the best on your website in terms of views?

9. Do you think strictly science stories or feature-based science stories would do better on your website?

10. Do you think that you as a journalist have a responsibility to your readers to cover these tough scientific topics?

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ACADEMIC VITA

PHILIP (NAVIN) ZACHARIAH

EDUCATION

The Pennsylvania State University | Schreyer Honors College — **University Park, PA**
Eberly College of Science | Bachelor of Science in Biology, Neuroscience Option — Graduation: May 2019
College of Communications | Certificate in Sports Journalism from the John Curley Center

PROFESSIONAL EXPERIENCE

Girirajan Laboratory — **University Park, PA**
Undergraduate Researcher — *Sep 2017 – Present*

- Utilized *Drosophila* as a model organism to further understand how changes in the genome can contribute to common neurodevelopmental disorders like autism and intellectual disability
- Set up crosses between male and virgin female flies of particular genotypes and assessed the resulting phenotypes through the lab's unique Flynotyper technology, which examined the ommatidial cells of fly eyes, and behaviors such as climbing ability
- Targeted research on the epigenetic nature of the *Drosophila* genome
- Connected the laboratory to the public using various communication methods such as writing and video elements

Penn State University Health Services — **University Park, PA**
Clinic Intern — *Jan 2018 – Present*

- Selected from a competitive group of applicants and charged with handling patient intakes by doing tasks such as updating medical records, taking blood pressure and collecting urine samples
- Maintained clinic's daily schedule by ensuring patient rooms were both sanitary and prepared for appointments
- Observed physicians conducting both surgeries and routine patient visits

Atlantis Project — **Vigo, Spain**
Fellow — *May 2017 – Jun 2017*

- Shadowed neurosurgical and cardiovascular departments and received unique opportunity to observe brain and heart surgeries
- Rounded with physicians and used opportunity to interact with patients using both the English and Spanish languages
- Learned valuable differences between European and American healthcare and discovered unique perspectives for patient care

Onward State/The Daily Collegian — **University Park, PA**
Writer — *Aug 2015 – Present*

- Covered the Penn State women's soccer team in the fall and the Penn State men's lacrosse team in the spring
- Detailed the Penn State science community, including features on various campus laboratories and researchers
- Produced weekly features on other various aspects of student life around campus

LEADERSHIP

Penn State THON — **University Park, PA**
Security Leader/Committee Member — *Sep 2016 – Present*

- Led a 25-member committee during Penn State's Dance Marathon event in ensuring the safety of visiting THON children, families, students and volunteers by supervising event, enforcing rules and solving spectators' problems
- Transformed the event's venue into the vibrant atmosphere unique to THON during set up, maintained its operational efficiency throughout THON weekend and cleaned the arena following the 46 hours of dancing
- Entered checks from various donors as a finance committee member to help tally a final fundraising total for the year's efforts

Men and Women Against Cancer at Penn State — **University Park, PA**
Founding Member — *Aug 2015 – May 2016*

- Raised funds for both breast and prostate cancer research from students, faculty and local businesses
- Collected supplies for patients undergoing treatment, raised awareness for breast and prostate cancer throughout Penn State main campus, organized main event in the HUB-Robeson Center where related student organizations set up informational booths and a keynote speaker discussed prostate cancer

AWARDS, HONORS & INTERESTS

Awards: Schreyer Honors College Academic Excellence Scholarship, Erickson Discovery Grant for Undergraduate Research at Penn State, National Scholastic Press Association's 2014 5th Place Sports Story of the Year, Pennsylvania Newspaper Association's Keystone Press 2013 1st Place Sports Story of the Year and 2014 1st Place Personality Profile of the Year
Honors: Schreyer Honors College "Leadership Jumpstart" Program (2015), Atlantis Project Fellowship (2017), Dean's List (2016-2019)
Interests: Philadelphia sports teams, basketball, soccer, drums, piano, writing, traveling, ping pong, *Friends, Psych, Lost*