AIP FOCUS ON

October 2022

Postgraduation Planning During a Pandemic:

Effects of COVID-19 on Physics and Astronomy Seniors' Career Paths

Anne Marie Porter and Patrick Mulvey

Results from the 2021 Survey of Physics and Astronomy Seniors

In this report we explore how and why undergraduate students' career and education plans changed as a result of the COVID-19 pandemic. We found that when students changed their plans, they were more likely to pursue employment instead of graduate education. Students reported that their plans changed due to not being accepted into graduate school, feeling unprepared to apply, or losing interest in applying. Students also adjusted their plans centering around employment outcomes, travel, and their undergraduate degree. A regression analysis showed that several factors impacted student plan changes. Students were more likely to change their plans if they experienced financial strain, loss of internship/job opportunities, graduation delays, less university support, and if they identified as Asian or Asian American. Universities, departments, and faculty members can use these findings and recommendations to recognize where additional student support may be needed, to help students achieve their career aspirations.

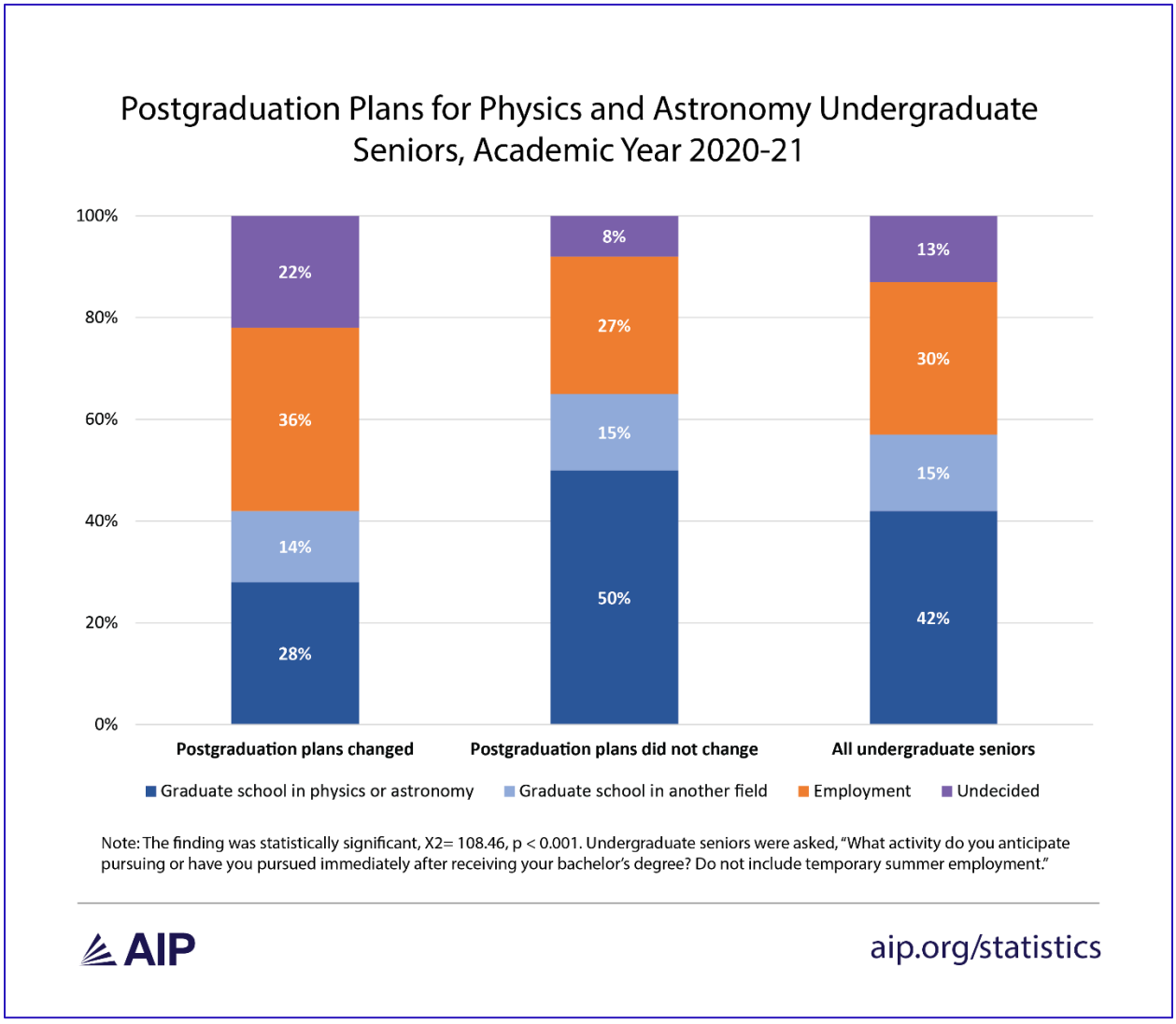
Additionally, this report includes data on students' postgraduation outcomes a year later. The majority (77%) of student outcomes were consistent with their original plans to attend graduate school or seek employment. Students who had different outcomes a year later were more likely to switch from graduate study to employment.

Typically, students earning bachelor's degrees in physics and astronomy follow one of two paths: they immediately pursue graduate studies, or they enter the workforce. The decision about which path to follow is often solidified during a student's senior year of study. These students are developing and sending out resumes to prospective employers or taking GRE exams and submitting applications to graduate programs, or possibly pursuing both options.

In our survey, undergraduate seniors in physics and astronomy reported the COVID-19 pandemic had a substantial effect on their experiences. Courses transitioned to online learning environments. Meanwhile, many students lost access to research equipment and labs, were unable to complete final projects, felt burnt-out and isolated, and had fewer opportunities to interact with faculty members and fellow students. With all these pandemic-related stressors happening in their senior year, many undergraduate seniors re-evaluated their post-degree career and continuing education plans.

When we asked undergraduate seniors about their postgraduation plans, more than one-third (36%) reported their plans changed because of the COVID-19 pandemic[1]. **Figure 1** compares the aspirations of seniors whose plans did and did not change. Those who changed their plans were more likely to pursue employment after graduating or remained undecided about the next step in their career path. We have not asked about changes in plans on previous questionnaires, so we cannot know the true extent to which the changes are COVID-driven or are simply typical behavior.

Figure 1



[1] We asked students "Have your post-degree plans changed as a result of the COVID-19 pandemic?" Students could answer yes or no.

What Seniors Say About Changes in Plans

In an open-ended question, we asked the 36% undergraduate seniors whose plans changed to elaborate on how and why these changes occurred as a result of the COVID-19 pandemic. We learned that the disruptive nature of the pandemic influenced seniors' post-degree aspirations in a variety of ways (**Table 1**).

There were various reasons given for these decisions, including increased applicant competition for graduate school admissions, financial strain, lack of employment opportunities, COVID-19 restrictions, graduation delays, decreased self-confidence, and poor experiences in online courses. We classified the reasons into four areas of change: graduate school plans and outcomes, employment plans and outcomes, undergraduate degree plans and outcomes, and travel plans and outcomes.

Table 1

How and Why Undergraduate Physics and Astronomy Seniors' Postgraduation Plans and Outcomes Changed as a Result of the COVID-19 Pandemic, Academic Year 2020-21

Changes in Graduate School Plans and Outcomes	**Pandemic-Related Reasons for the Change**
Not accepted to graduate school as planned	More competitive applicant pool, programs closed, lack of research experience, GPA too low, lack of support from advisors in applications
Decided not to apply to graduate school anymore	Negative experience in courses, need money, too competitive, not confident about getting in, school too stressful, GPA too low, not enough research experience, decided on employment instead, no longer interested in more school
Delayed applying/took a gap year instead of applying to graduate school right away	Need more research experience, difficulty taking entrance exams, missed application deadlines, too busy to apply, burnt-out from school, preferred not to start online
Decided to apply to graduate school instead of pursuing employment	Lack of job opportunities
Decided to apply to graduate school sooner than planned	Waived application requirements
Applied to a master's program or different PhD program than planned	More competitive applicant pool, difficulty taking GRE, graduation delays, prefer schools that waive GRE requirements
Changes in Employment Plans and Outcomes	**Pandemic-Related Reasons for the Change**
Lost a job/internship or not offered a job/internship as planned	Lack of job opportunities, not enough experience or high enough GPA for internships, unable to get work visas
Changed field of study to something else	Negative experience in courses, need more money, lack of confidence in field, lack of job opportunities
Changed jobs	Lack of job opportunities, want all-remote positions
Remained in a job instead of changing jobs	Need financial security
Started a job later than planned	Not enough job experience
Changes in Undergraduate Degree Plans and Outcomes	**Pandemic-Related Reasons for the Change**
Graduated later than planned	Courses not offered, mental health challenges and burnout
Graduated sooner than planned	Too expensive, negative experience in courses
Decided not to continue school anymore	Too expensive, negative experience at school
Took a semester off	Mental health challenges and burnout, negative experience in courses, dislike online courses
Added an additional degree or minor	More job opportunities
Changes in Travel Plans and Outcomes	**Pandemic-Related Reasons for the Change**
Decided not to move or travel	Difficult to get job opportunities, need to save money, pandemic travel restrictions, less safe during pandemic
Decided to move back home	Want to help family, prefer to work near home
Decided to move to another area or country	Dislike how current location handled pandemic
Decided to travel more for leisure	Have more time off for travel

AIP aip.org/statistics

Quantitative Predictors of Seniors' Change in Plans

We further explored the possible reasons for these postgraduation plan changes using quantitative analyses. We ran a logistic regression to see which demographic, academic, and financial factors predicted a change in postgraduation plans or outcomes (**Table 2**). Paralleling many of the reasons described in the open-ended responses, postgraduation plans were more likely to change if seniors were worse off financially, lost or postponed career opportunities, delayed graduating, and were less satisfied with their university's services during the pandemic (e.g., mental health assistance, disability accommodations, COVID-19 testing, living accommodations, IT support).

We did not see any significant effects based on seniors' experiences with their departments, physics professors, or physics courses. Although the role of departments and courses was mentioned in the open-ended responses, the regression results show that they were not the driving factors in changing postgraduation plans or outcomes when controlling for other factors in statistical models.

Of the demographic variables, only students who identified as Asian or Asian American were more likely to have their plans change due to COVID-19. In follow-up analyses, we found that students who were Asian or Asian American were more likely than students from other race/ethnic groups to say they lost a research, internship, or job opportunity during COVID-19.

Table 2

Variables that Predict a Change in Undergraduate Physics and Astronomy Seniors' Postgraduation Plans During the COVID-19 Pandemic, Academic Year 2020-21

Variables Included in the Logistic Regression	Significance	Interpretation of Results
Demographics		
Race/Ethnicity (American Indian, Black or African American, Asian or Asian American, Pacific Islander, White, Hispanic, or Multiple Races)	Significant (only for Asian or Asian American students)	Undergraduate seniors who identified as Asian or Asian American were **more likely than White students** to have their plans change
Gender identity (Man, woman, or another identity)	Not significant	
Major (physics, astronomy, or double major)	Not significant	
Finances and Opportunities		
Financial status	Significant	Undergraduate seniors who were worse off financially were **more likely** to have their plans change
Lost or postponed a research, internship, or job opportunity	Significant	Undergraduate seniors who lost or postponed an opportunity were **more likely** to have their plans change
Received or maintained a research, internship, or job opportunity	Significant	Undergraduate seniors who received or maintained an opportunity were **less likely** to have their plans change
Delayed graduating for at least one semester	Significant	Undergraduate seniors who delayed graduating were **more likely** to have their plans change
Withdrew for at least one semester	Not significant	
Took time off to care for someone with COVID-19 or because of COVID-19	Not significant	
Academic Support during COVID		
Frequency of access to academic resources (e.g. laptops, internet, tutoring, quiet places, libraries)	Not significant	
Level of satisfaction with university services (e.g. IT, disability services, mental health services, dorms, COVID testing)	Significant	Undergraduate seniors who were less satisfied with their university's policies during COVID and programs were **more likely** to have their plans change
Level of support from physics and astronomy departments	Not significant	
Level of support from physics professors and students	Not significant	
Level of perceived belonging in physics courses	Not significant	
Level of confidence in succeeding in physics courses (labs, exams, assignments)	Not significant	
Level of confidence learning in online courses	Not significant	

Overall, the model was statistically significant, $X2\ (22, N = 982) = 132.82$, $p < 0.001$, and explained 17% of the variance (Nagelkerke R2). Significant findings had a p value < 0.05.

AIP aip.org/statistics

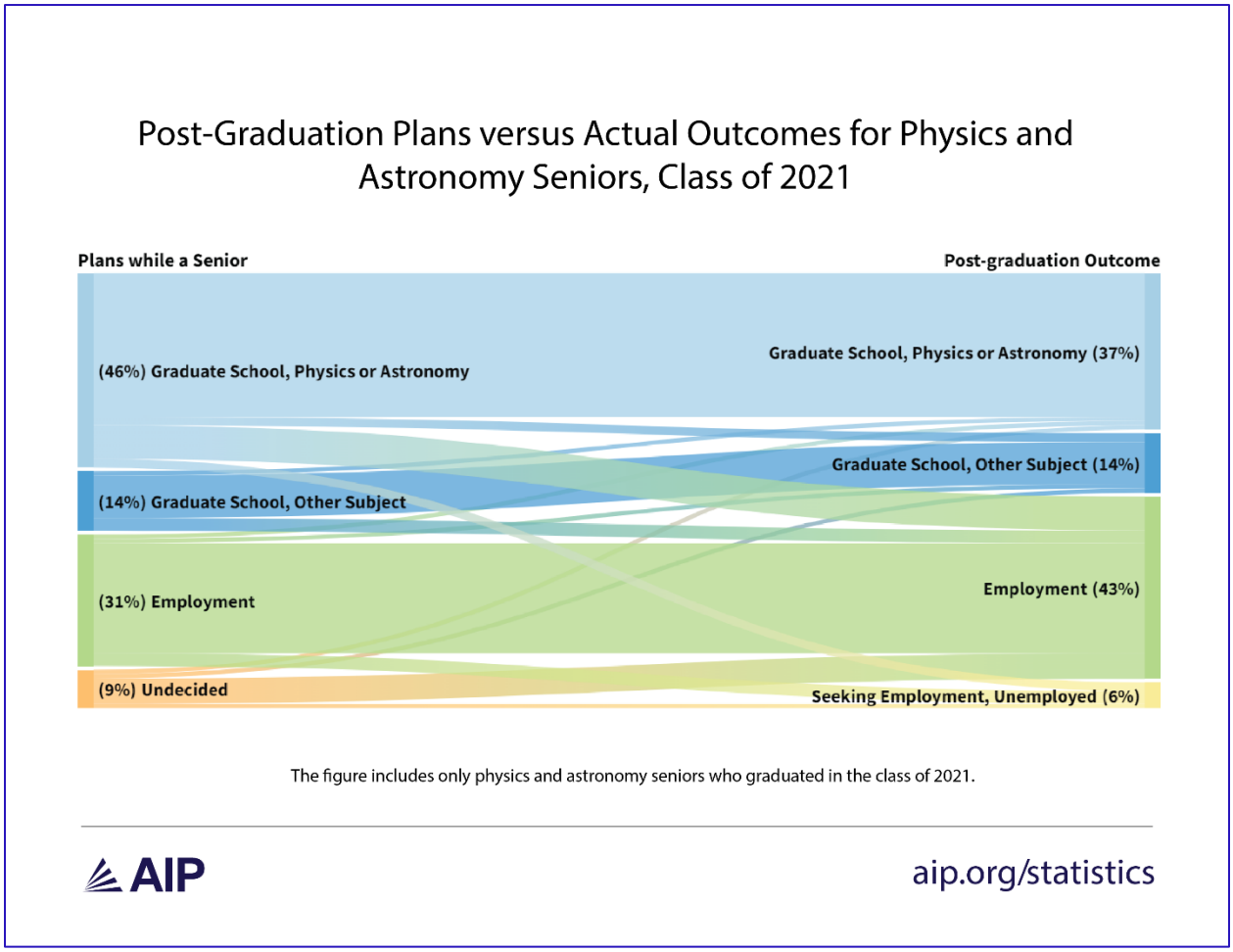
Where Are the Physics and Astronomy Seniors A Year Later?

The American Institute of Physics conducts an annual follow-up survey of physics and astronomy bachelors. Using the results of this survey we were able to compare the postgraduation plans of students who were seniors during 2020-2021 academic year with their actual postgraduation outcomes (**Figure 2).**

Over three-quarters (77%) of seniors had actual post-graduation outcomes that matched the post-graduation plan they had while a senior. For the 23% of seniors whose outcomes a year later did not match their original plans, the data show the predominant shift was from graduate study to employment. The majority of the students who indicated they were undecided concerning their postgraduation plans while they were a senior ultimately entered the workforce or were seeking employment a year later.

The follow-up survey did not ask why students' outcomes did not match their postgraduation plans while they were a senior in college.

Figure 2



Implications and Future Actions

A typical senior year for a physics or astronomy major can be a difficult and stressful time under normal circumstances. With the additional social and education complexities that the COVID-19 pandemic introduced, it is no wonder that one-third of undergraduate seniors changed their post-degree plans as a direct result of pandemic influences. Our findings show that when these plans changed during COVID-19, seniors were more likely to seek employment instead of graduate school in physics or astronomy. This is because seniors were not accepted to their preferred graduate program, could not afford it financially, no longer wanted to be in school, were suffering from burnout and mental health symptoms, or did not feel confident applying with their level of research experience and physics GPA. While COVID-19 may have affected some students' plans, most people's outcomes were consistent with their plans as a senior.

We also found that seniors who were Asian or Asian American were more likely than seniors from other race/ethnic groups to change their postgraduation plans. Our findings are limited in this study, and we are unable to fully explain the reasons for this difference. We encourage departments and faculty members to further explore and understand the experiences of these students.

Helping students remain on their desired career path is a complicated and multifaceted challenge for physics departments and faculty members to address, and it can be helpful to know where a department's time and resources could have the most impact. Our results show that the following factors influence career plan changes the most and could have the most impact when helping students achieve their intended career goals:

- Financial assistance to complete undergraduate degrees and attend graduate school if desired
- Department and advisor support to graduate on time
- Research, internships, and job opportunities
- Institutional policies and structures that provide support for technology issues, mental health resources, and accommodations for disabilities and extenuating life circumstances

Additional Resources

Further data from this survey addressing the student's perceptions of the COVID-related social dynamics of their department can be found in a *Physics Today* article, "Undergraduate Physics in the Age of COVID-19," https://physicstoday.scitation.org/do/10.1063/PT.6.5.20211102a/full/. The article highlights differences by race and gender for different social influences students encountered as a result of the COVID-19 pandemic, including confidence levels, sense of belonging, and departmental support.

EP3 Effective Practices for Physics Programs, a collaborative effort of The American Physical Society and American Association of Physics Teachers, is an excellent resource for departments looking to

reevaluate how they support their students and to explore which additional efforts they may want to consider implementing. EP3 provides actionable steps on how to implement systematic departmental improvements (see https://ep3guide.org/).

Methodology

Each fall the Statistical Research Center conducts the Survey of Enrollments and Degrees. This survey asks physics and astronomy departments to provide information on the number of students enrolled and the number of recent degrees conferred the previous academic year. This survey also asks for the names and emails of current senior-level students and recent degree recipients. In the spring of 2021 this contact information was used to conduct a survey of physics and astronomy seniors.

In the fall of 2020 departments reported enrollments of approximately 15,200 senior-level physics and astronomy majors. We received contact information for about 10,000 of these students. In the spring of 2021, seniors were emailed up to four invitations to participate in the survey. We received responses from over 2,100 students and included 1,823 students in the analysis for this report.

In the fall of 2021 departments provided the names and contact information for their physics and astronomy bachelors in the class of 2021. These bachelors were asked to complete a degree recipient follow-up survey in February of 2022. We were able to match up the responses of 725 individuals who responded to both the senior survey and the follow-up survey. It is these individuals that are presented in Figure 2 of this report.

For the regression analysis, some variables were created by calculating an average across multiple items. "Frequency of access to academic resources" was 11 items, "satisfaction with university services" was 12 items, "support from physics and astronomy departments" was 5 items, "support from physics professors and students" was 4 items, "confidence in succeeding in physics courses" was 3 items. "Perceived belonging in physics courses" and "confidence learning in online courses" were each 1 item.

We thank the many physics and astronomy departments for providing their senior's and bachelors recipients contact information and the seniors and bachelors who contributed their experiences via our surveys.

e-Updates

You can sign up to receive email alerts that notify you when we post a new report or resource. Visit https://www.aip.org/subscribe-statistics-e-updates to sign up. We will send you an e-Update only when we post something new. You should receive no more than 20 messages in a year.

Follow Us on Twitter

The Statistical Research Center is your source for data on education, careers, and diversity in physics, astronomy, and other physical sciences. Follow us at @AIP_Stats.

How the Pandemic Changed Postgraduation Plans for Seniors Majoring in Physics and Astronomy

By Anne Marie Porter and Patrick Mulvey

October 2022

A product of the Statistical Research Center of the American Institute of Physics

1 Physics Ellipse, College Park, MD 20740

stats@aip.org | 301.209.3070 | aip.org/statistics