

Barriers to Securing Industry Internships in Computing

Amanpreet Kapoor & Christina Gardner-McCune, Ph.D.

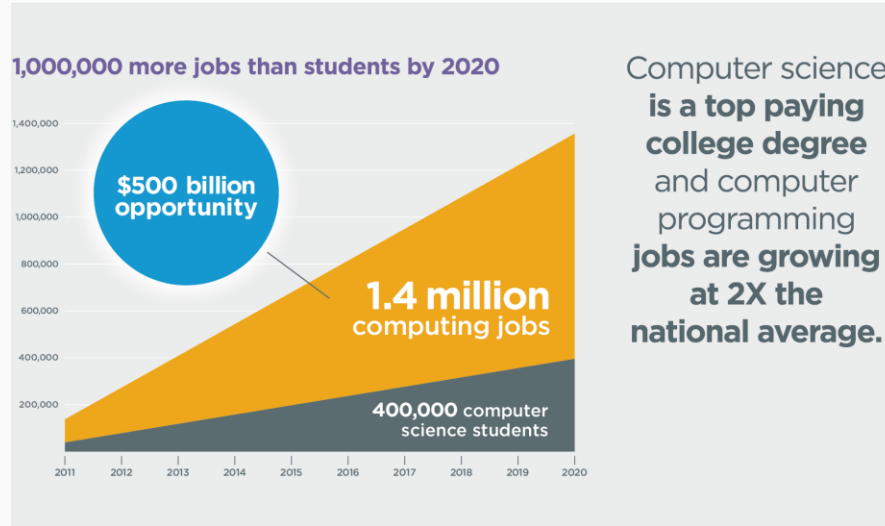
Engaging Learning Lab

Computer and Information Science and Engineering

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Motivation

Ubiquity of Computing Jobs in the Coming Decade

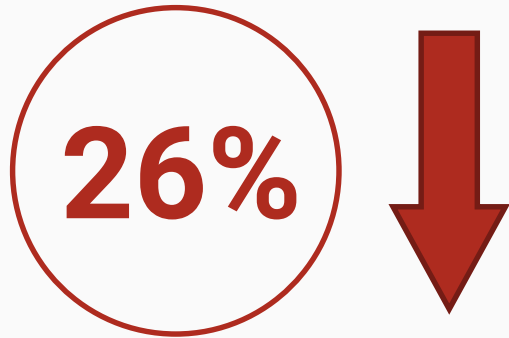


Source: <https://code.org/images/cs-stats/more-jobs-than-students.png>

Motivation

Underprepared Computing Graduates

Underemployed CS Recent Graduates



Employers report CS graduates **lack**

- Technical abilities
- Personal skills
- Professional skills

Source: The Labor Market for Recent College Graduates
https://www.newyorkfed.org/research/college-labor-market/college-labor-market_compare-majors.html.

Sources: Brechner. Things they would not teach me of in college (OOPSLA 2003); Radermacher & Walia. Gaps between industry expectations and the abilities of graduates (SIGCSE 2013, ICSE 2014);

Create pathways for smooth **transition** of students from **college to industry** ensuring that the CS graduates are **technically and professionally** competent.

Source

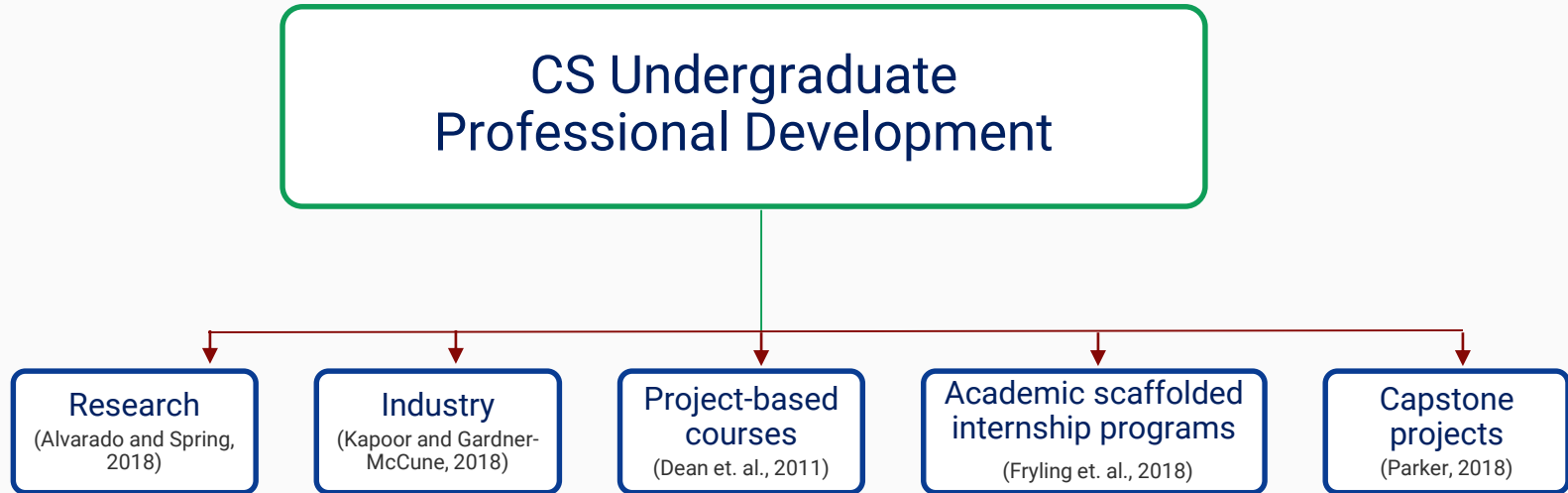
Joint Task Force on Computing Curricula, Association for Computing Machinery (ACM) and IEEE Computer Society. 2013. Computer Science Curricula 2013: Curriculum Guidelines for Undergraduate Degree Programs in Computer Science. Association for Computing Machinery, New York, NY, USA.

Create pathways for smooth **transition** of students from **college to industry** ensuring **technically and professionally** competent CS graduates.



PROFESSIONAL DEVELOPMENT

Existing Research in CS Undergraduate Professional Development



Source

- Alvarado and Spring (2018). Successfully Engaging Early Undergraduates in CS Research. SIGCSE '18
- Kapoor and Gardner-McCune (2019). Understanding CS Undergraduate Students' Professional Development through the Lens of Internship Experiences. SIGCSE '19
- Dean, Lynch, and Ramnath (2011). Student perspectives on learning through developing software for the real world. FIE '11
- Fryling, Egan, Flatland, Vandenberg, and Small (2018). Catch 'em Early: Internship and Assistantship CS Mentoring Programs for Underclassmen. SIGCSE '18
- Parker (2018). Developing Software Engineers: A study of professionalization in a CS Senior Capstone. SIGCSE '18

Professional Development through Internships

Internships

- Gain authentic experiences^{1,2}
- Build technical skills^{1,2}
- Develop professional skills^{1,2}
- Secure future employment³

Source

1. Amanpreet Kapoor, Christina Gardner-McCune. 2019. Understanding CS Undergraduate Students' Professional Development through the Lens of Internship Experiences. SIGCSE '19
2. Joann J. Ordille. Internships Enhance Student Research and Educational Experiences. https://cra.org/crn/2008/11/internships_enhance_student_research_and_educational_experiences/
3. National Association of Colleges and Employers. 2014. The Class of 2014 Student Survey Report. Bethlehem. Retrieved August 31, 2018 from www.naceweb.org

Professional Development through Internships

Internships

- Gain authentic experiences^{1,2}
- Build technical skills^{1,2}
- Develop professional skills^{1,2}
- Secure future employment³



Participation in Internships before Graduation across all majors in the US³

Source

1. Amanpreet Kapoor, Christina Gardner-McCune. 2019. Understanding CS Undergraduate Students' Professional Development through the Lens of Internship Experiences. SIGCSE '19
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3. National Association of Colleges and Employers. 2014. The Class of 2014 Student Survey Report. Bethlehem. Retrieved August 31, 2018 from www.naceweb.org

What **barriers** do CS undergraduate students, who do not intern, **encounter in securing an industry internship?**

Theoretical Framework: Social Cognitive Theory (1989)

Bandura's Social Cognitive Theory elaborates on

- (1) Human agency : actual ability to deal with a complex task
- (2) Self-efficacy : the belief that one has about their capacity for specific achievements, given domain-specific obstacles

People who develop their **competencies, self-regulatory skills, and enabling beliefs in their efficacy** are more successful in realizing desired futures than those with less developed agentic resources.

Source

Albert Bandura (1989). Human agency in social cognitive theory

Theoretical Framework: Social Cognitive Career Theory (2004)

Lent, Brown, and Hackett's Social Cognitive Career Theory (SCCT) elaborates on

- (1) formation of career-relevant interests;
- (2) selection of career choices;
- (3) performance and persistence in educational and occupational pursuits

People are likely to develop interest and **pursue a career** if they have **strong self-efficacy beliefs, outcome expectations, and environmental support** for gaining professional competence.

Source

Lent, Brown, and Hackett (2004). Towards a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance.

Typical Hiring Process for Internships in USA

Applying at Career Fairs or Online for Paid/Unpaid/Coop Internships in Computing Disciplines

Screening of Resume by Application Tracking System, Referrals, or Recruiters or a Technical/Aptitude Test

0-4 remote or in-person Technical (Coding + Data Structures + System Design), and/or Behavioral interviews.

Expectations: Technical Skills + Professional Skills + Working outside the curriculum

Study Design & Institutions

- **Cross-sectional** mixed-methods (survey and interview) study at two large public R1 universities in South East USA in Spring 2019

- University of Florida
- Georgia Institute of Technology

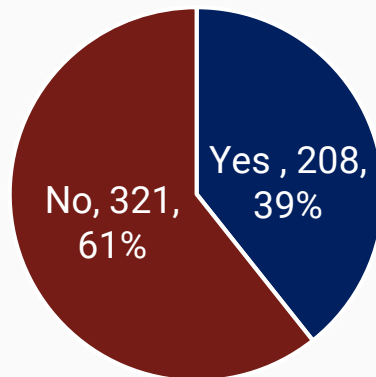


- At both universities

- Students can choose a major when they start college but can change at anytime
- Internship is not required for graduation

Participants included in Data Analysis

Participation in Internship before Graduation (N=529)



Dataset:

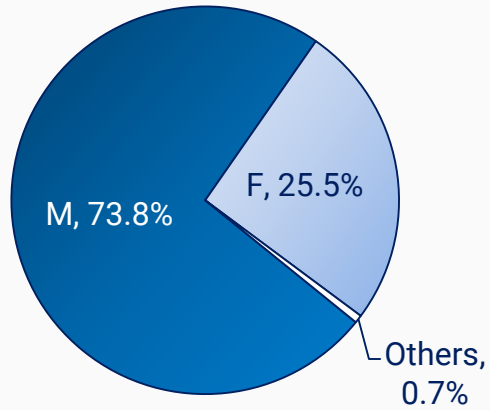
302 students who never interned or were not interning the summer following the study

Participants included in Data Analysis

- N = 302
 - University of Florida (n=285, Response Rate: 44.0%)
 - Georgia Institute of Technology (n=17, Response Rate: 18.4%)
- Average Age: 21.1 years (SD: 4.1)
- Average GPA: 3.44 (SD: 0.47)
- Recruitment through
 - Extra credit in Computing Courses (n=299)
 - Random Gift Card (n=3)

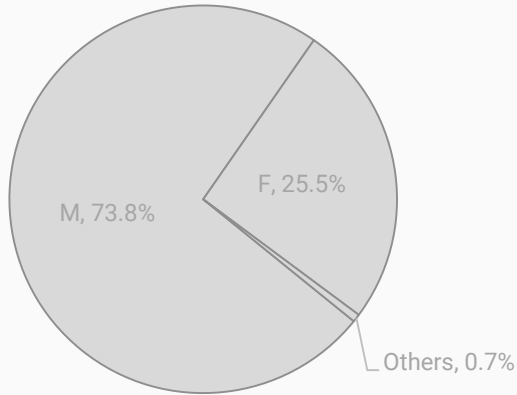
Participant Demographics

Gender Identity, N=302

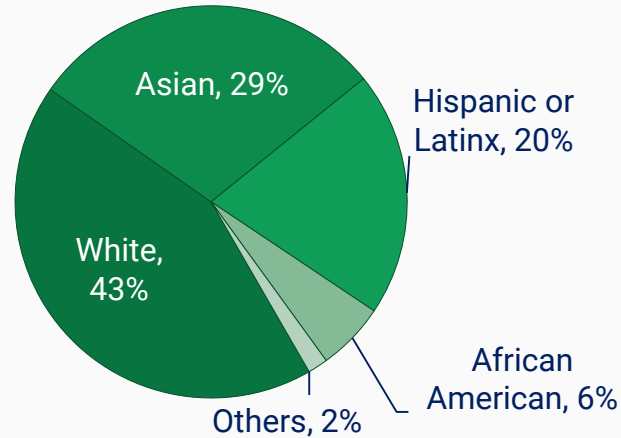


Participant Demographics

Gender Identity, N=302

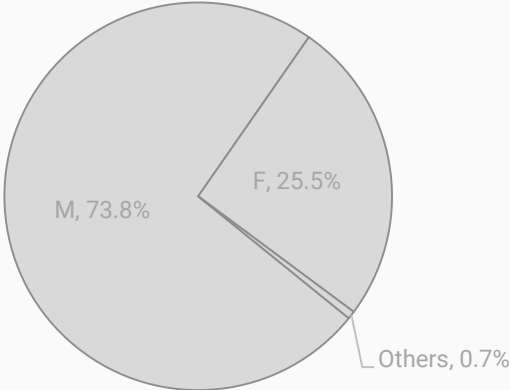


Racial/Ethnic Identity, N=302

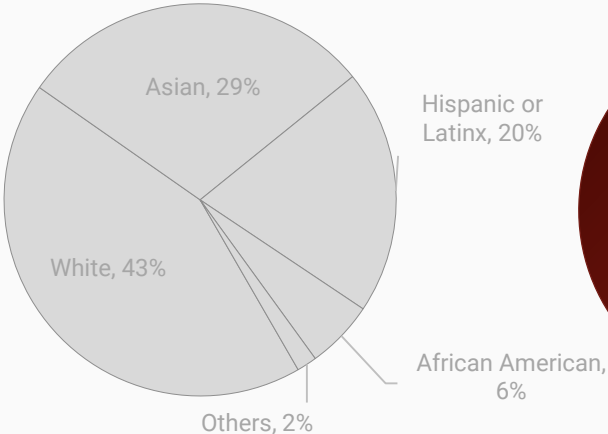


Participant Demographics

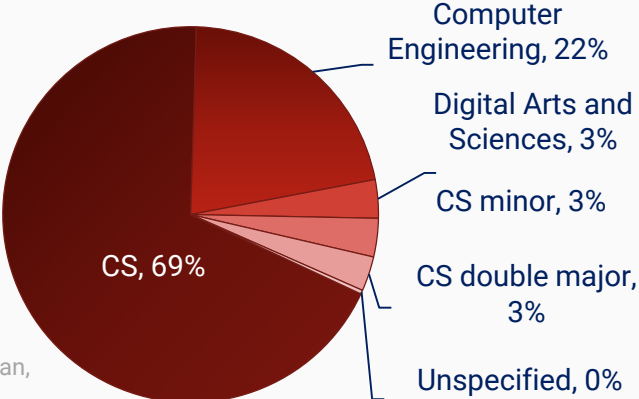
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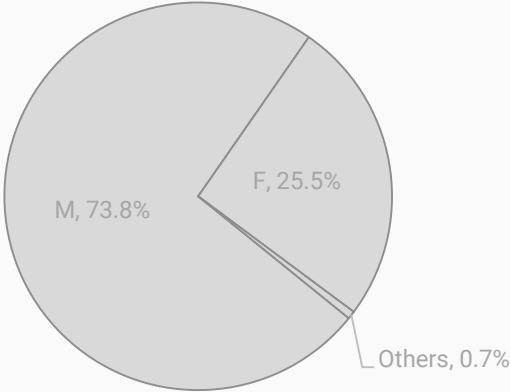


Major, N=302

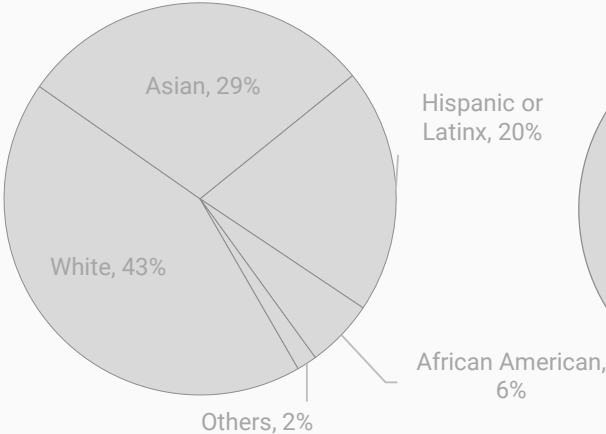


Participant Demographics

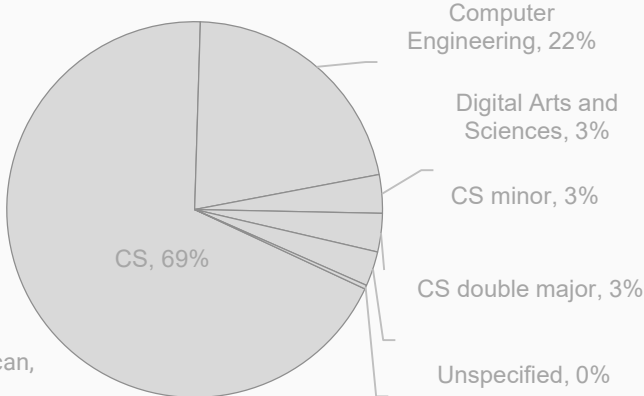
Gender Identity, N=302



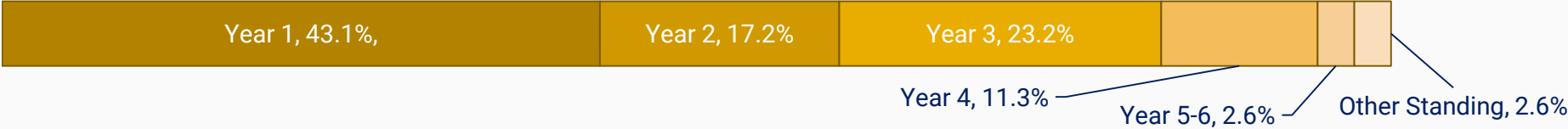
Racial/Ethnic Identity, N=302



Major, N=302



Academic Year, N=302



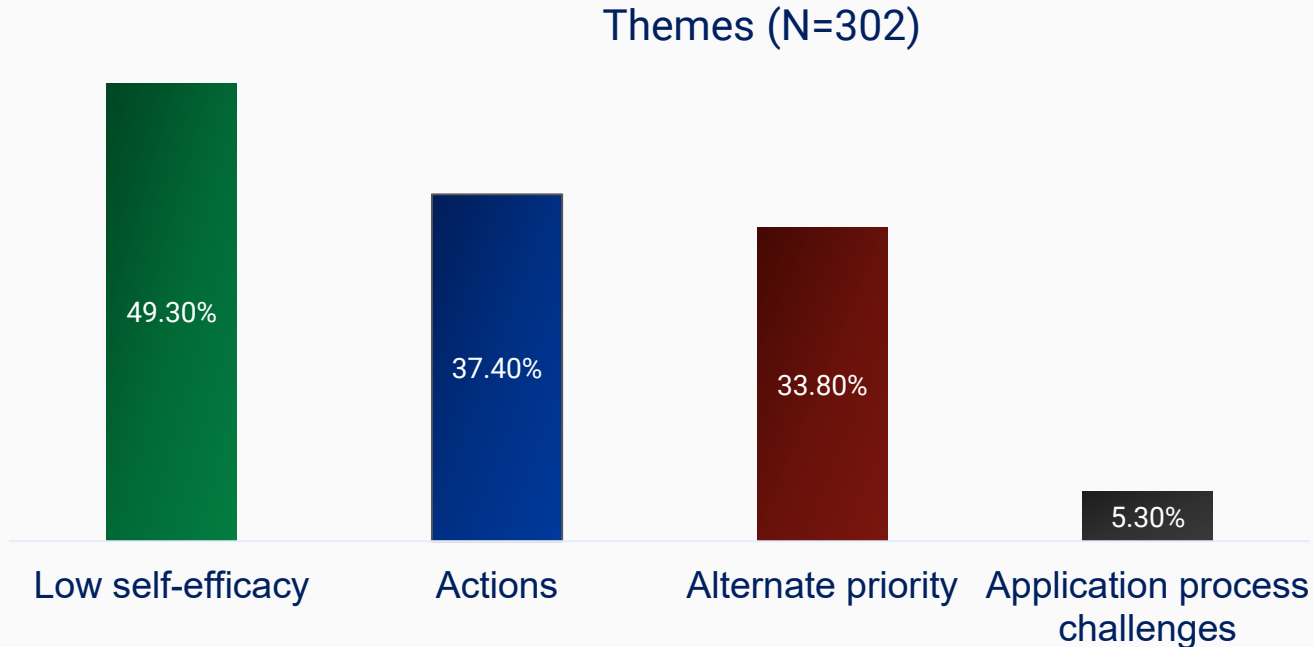
Data Collection and Analysis

Why haven't you interned so far?

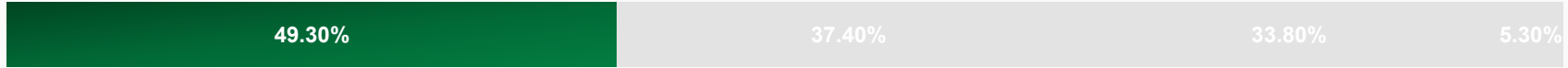
Raw Data	I'm not sure how to begin finding an internship and I have a lot of anxiety and feel incompetent. -P327, Year 3 Female	I think because I lack the skills and personal projects to compete with much more experienced students. -P382, Year 5-6 Female	Lack of adequate experience as a freshman, course load and study abroad as a sophomore. -P722, Year 2, Female
Primary Code	Intimidation to apply	Self-evaluation: lack of skills	Self-evaluation: lack of experience
Categories	Lack of Confidence and Fear	Self-evaluation: lack of skills and experience	
Themes	Low self-efficacy		

Findings

RQ. What **barriers** do CS undergraduate students, who do not intern, encounter in **securing** an industry **internship**?



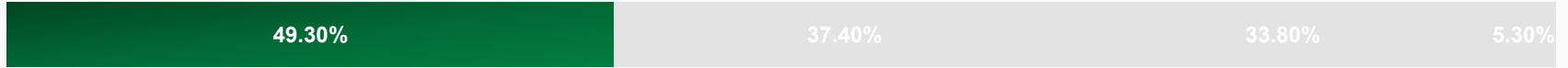
Findings : Barriers to Securing Internships



Low self-efficacy (n=149)

- **Self evaluating** as technically incompetent (n=85) through lack of experience in appropriate coursework, or little/no involvement in activities outside of coursework such as personal projects and technical interview preparation.
- Expressed lower self-efficacy by using “**age**”, “**academic status**”, or “**year in degree program**” as a **proxy for knowledge** (n=71).
- Reported **lacking dispositional traits** through feelings such as lack of “**confidence**” or felt “**intimidated**” to apply (n=19).

Findings : Barriers to Securing Internships



Low self-efficacy (n=149)

“**Not enough experience** or intriguing personal projects; **Lack of experience**, work-wise and coding-wise.”

- P376, Senior Male

Findings : Barriers to Securing Internships



Low self-efficacy (n=149)

“Not enough experience or intriguing personal projects; Lack of experience, work-wise and coding-wise.”

- P376, Senior Male

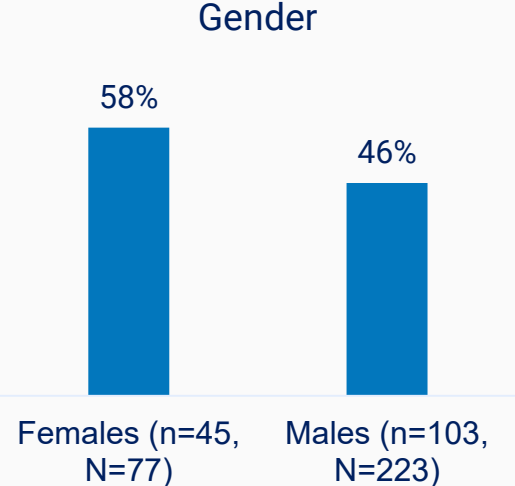
“I am **not very far in the computer science major** yet and I have not gone seeking out internships.”

-P287, Sophomore Female

Findings : Barriers to Securing Internships



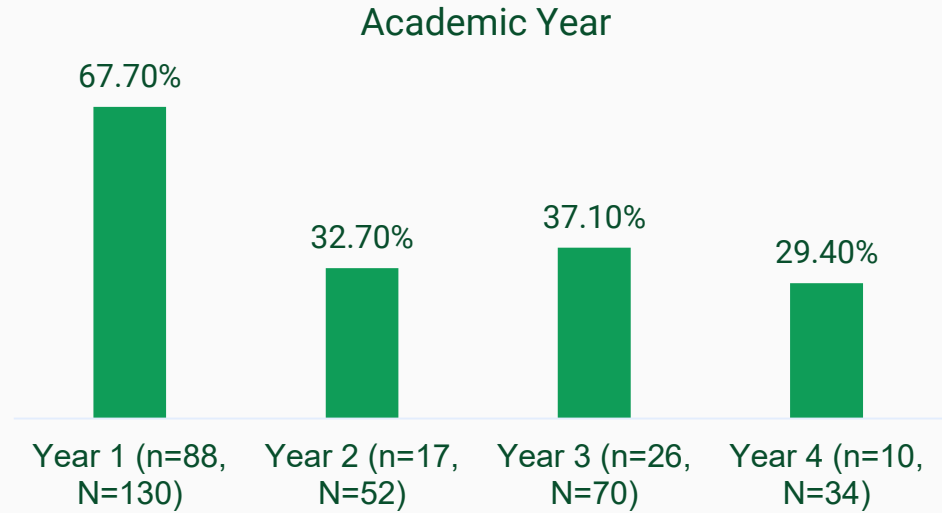
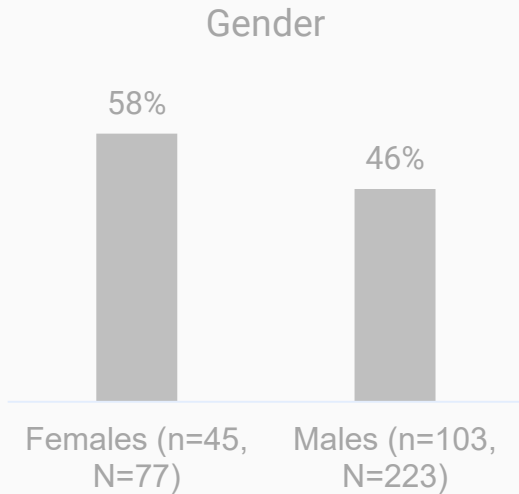
Low self-efficacy (n=149)



Findings : Barriers to Securing Internships



Low self-efficacy (n=149)



Findings : Barriers to Securing Internships



Actions (n=113)

- Applying but failing due to less involvement, technical interview challenges, etc. (n=47)
- Not applying due to low GPA, low confidence, socio-economic challenges, etc. (n=31)
- Will apply in future and working on building skillset (n=18)
- Ambiguity on intent to apply (n=13)
- Applied-secured-and-declined (n=5) due to low offered stipend, shifting priorities
- Not applying because of secured full-time employment (n=2)

Findings : Barriers to Securing Internships



Actions (n=113)

“I **haven't applied**, I had a job to support my living and school expenses and leaving for an internship would have been too much strain on me. I **support myself**, so I couldn't lean on my parent's **financials**.”

-P183, Senior Male

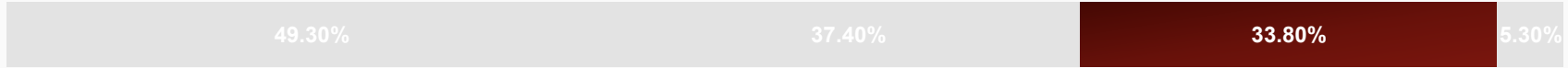
Findings : Barriers to Securing Internships



Alternate priority (n=102)

- Coursework or GPA (n=67) : managing time was difficult or believed coursework would prepare them
- Work/Financial or Family responsibilities (n=26)
- Involvement in activities outside of coursework in summer (n=14)
- Health conditions (n=2)

Findings : Barriers to Securing Internships



Alternate priority (n=102)

“I wanted to **get further along with my courses** and leave my internship for my last semester, this would allow me to hopefully transition into a job easier.”

- P364, Junior Male

Findings : Barriers to Securing Internships



Alternate priority (n=102)

“I wanted to **get further along with my courses** and leave my internship for my last semester, this would allow me to hopefully transition into a job easier.”

- P364, Junior Male

“I haven't had the time since I have a **job and classes**, and I don't think I'm far enough into the major to be able to take on an internship.”

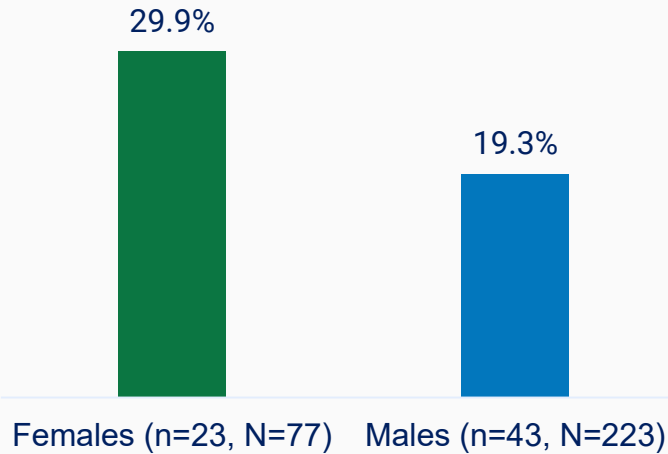
- P654, Sophomore Female

Findings : Barriers to Securing Internships



Alternate priority (n=102)

Coursework/GPA



Family/Work Responsibilities



Findings : Barriers to Securing Internships

49.30%

37.40%

33.80%

5.30%

Application process challenges (n=16)

- Limited knowledge of how and where to apply for internship positions
- Lacked connections to apply for internships
- Visa restrictions

Findings : Barriers to Securing Internships

49.30%

37.40%

33.80%

5.30%

Application process challenges (n=16)

“I find it **hard to find a company** that will give me an internship in something I am interested in such as cybersecurity.”

- P591 Sophomore Male

Findings : Barriers to Securing Internships

49.30%

37.40%

33.80%

5.30%

Application process challenges (n=16)

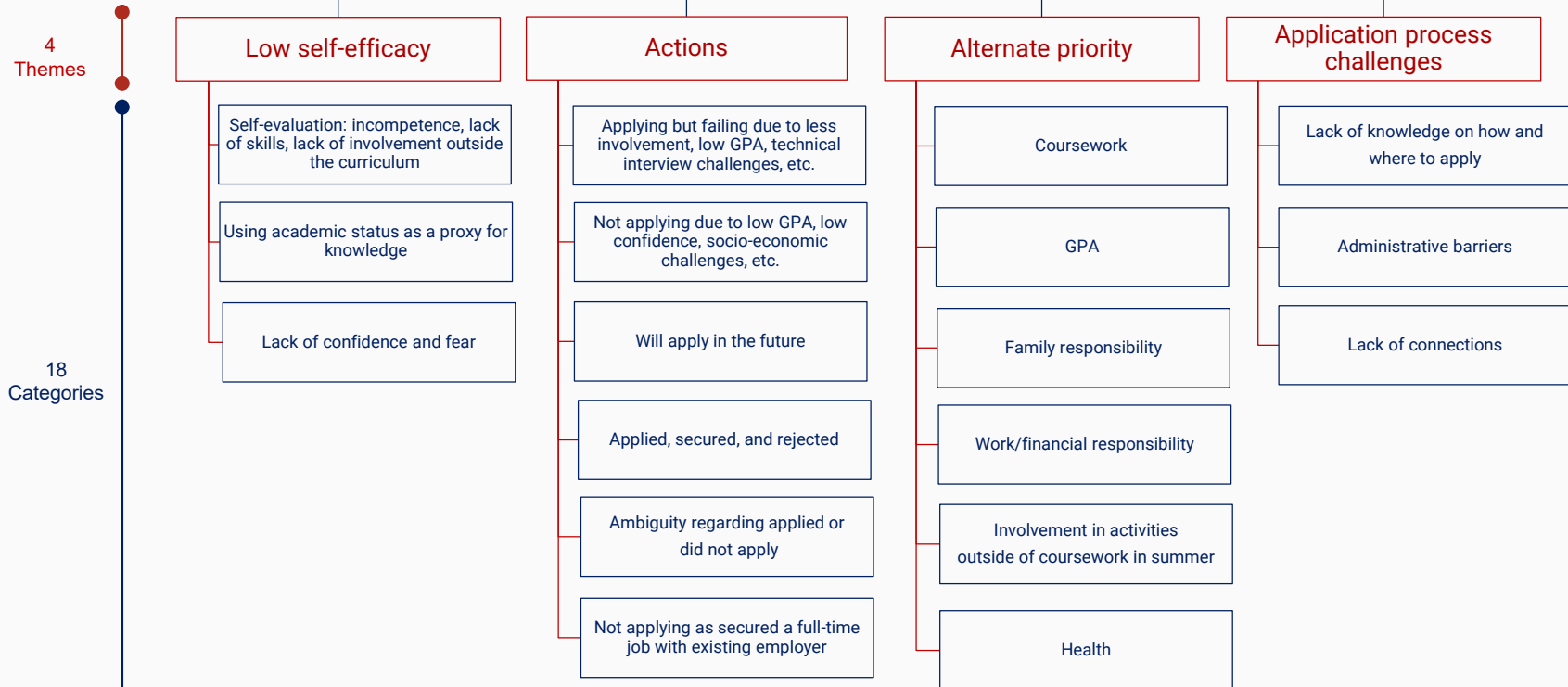
“I find it **hard to find a company** that will give me an internship in something I am interested in such as cybersecurity.”

- P591 Sophomore Male

“I have not interned so far because my **status** with the United States does not allow me to obtain a job.”

- P129 Freshman Female

Findings



- Students' **self-evaluation** of their skillset
- Students' **misconceptions** regarding internship process
- SCCT suggests that during the career exploration process students face obstacles that hinder the formation of performance goals

Students lacked the necessary agency to form performance goals

Source

Lent, Brown, and Hackett (2004). Towards a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance.

Key Takeaways

CS students fail to secure an internship not only due to less technical proficiency, but also due to :



Psychological constraints
E.g. low self-efficacy and
lack of agency



Social constraints
e.g. family responsibilities



Financial constraints
e.g. work responsibilities



Recruitment-process constraints
e.g. involvement in projects & extra-
curricular activities

Recommendations

- Departments should **support** specific **professional development programs** targeting students who have work/family responsibilities or for **building students' confidence**
- Departments must disseminate the **importance of pursuing internships**
- Instructors must **incorporate authentic skills** required from the industry recruitment process within the curriculum so that all students can balance coursework with professional development

Acknowledgements



Data Collection

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UF Graduate
Student Council



Any opinions, findings, conclusions, or recommendations expressed in this presentation are those of the authors.

Questions?



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