Analyzing factors that influence post-graduate decision

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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INTRODUCTION

The current state of Computer Science (CS) is in an interesting state. The world around us has started to become more dependent on technology and innovation. As a result, computer science and other related fields, such as Artificial Intelligence, have continued to gather interest. As a result, recent trends show that many students studying in university have decided to pursue an education in CS. Data shows that the number of CS majors has more than tripled between 2006 and 2016 (Camp et al., 2017). Reasons for this can be attributed to many different factors, but the near unlimited potential in both profitability and creativity make the field enticing for those pursuing a career. However, while reviewing the statistics related to university CS programs and the job market related to tech, an oddity arises; graduate students. Despite the prospects of high paying jobs and promising futures, there lies a small group of individuals that decide to forgo these upfront opportunities in order to pursue further education. As such, it is necessary to investigate the following population of CS graduate students to understand why these individuals decide to pursue a further education.

BACKGROUND

In order to analyze why certain students are choosing grad school over industry, it's important to understand the system in place that leads to our current situation. Technology, especially computers and software, has become more prominent within our society. Tools, such as artificial intelligence and automation, have allowed organizations to rapidly increase their production speeds, resulting in a market that is experiencing a pace of innovation that is much harder to keep up with. As a result, organizations have a much greater need to recruit prominent personnel within computer science, data science and information technology to develop and

maintain products created. Data collected on the return on investment related to higher education shows that a completion of a college degree, specifically a bachelor's degree, can result in an average of 75-85% higher lifetime earnings, with varying numbers depending on college major and occupation following graduation (Oreopoulos et al., 2013). The greater need for personnel in the tech sector, the increasing dependency on technology and growing interest in the field creates the perfect opportunity for students to jump into industry. As such, graduate students pose an interesting question of why these students still continue with their education. The following research topic will attempt to analyze two major ideas related to this question.

First, what are some factors that influence the decision to pursue a postgraduate degree? Understanding the underlying commonality between different graduate students may help us understand if there are distinct factors that determine if someone is more likely to make the decision to continue with their studies. A similar study completed in Hispanic Serving Institutions (HSIs) have shown that gender may have a large influence on a student's likelihood to declare a STEM degree, change into a STEM major or earn a STEM degree (Crisp et al., 2009). Notes were made that other factors, such as parental education, first-generation college student status and transfer status also played a role in determining if a student was more likely to pursue a STEM degree, albeit on a lesser degree when compared to the results derived from the data related to gender. Another similar study investigates the effects of gender and societal norms on college students studying in STEM at different Chinese institutions (Yao, 2023). Data from the following study shows that despite having a greater female population within the institutions, women were more unlikely to pursue graduate studies. This can be attributed to a variety of reasons, such as a lack of representation and role models within the field, as well as

issues related to parenthood timing. The current study attempts to do similar research on what factors may influence the decision to pursue a further education in CS, specifically in UVA.

Second, is there a difference between individuals who pursue a postgraduate degree immediately after their undergraduate careers, those who pursue a postgraduate degree later on in their careers and those who don't pursue a postgraduate degree? Completing a cross-analysis of these different groups may help identify factors that differentiate each group of individuals in why they decide with a certain procedure in procuring their postgraduate degree. A recent study completed with a subject group of returners, defined as graduate students who have decided to return to postgraduate education later in life, from different fields of study was completed to understand why they decided to return to education to pursue a postgraduate degree and what differences this makes (Peters et al., 2013). A summary of the interviews concluded two major points: 1) Returners contributed to the learning and research environment by providing different perspectives from direct-path students and 2) Many returners stated that their decision to return to education was related to a high expectancy to succeed following completion of their graduate degrees. One note made from these interview participants suggested that finding ways to identify and mitigate potential issues, such as a lack of a proper support group, was key in allowing returners to effectively plan and complete their postgraduate careers. A study from the Georgia Institute of Technology looks into this from a different perspective by documenting student perception of CS between two different subject groups, graduate CS seniors and those who have switched majors from CS during their undergraduate career (Briggers et al., 2008). Factors such as loss of interest within the field, poor grades and heavy workload were key factors in pushing students to change majors from CS. Previous research completed clearly indicates that there are

some correlations between student perception of their field of study and their likelihood of completing their undergraduate degree and continuing in further education.

RESEARCH DESIGN

RESEARCH QUESTION

The following study focuses on the decision making process of computer science students from and at the University of Virginia in regards to the goals, advice and plans that these students have in mind when making their decision regarding graduate school. The following research questions will act as a general guide in how to proceed: What made you decide to enter a graduate program? What kind of advice/influences were present during the decision making process? Did you have any prior work/educational experience that changed your stance? What interests do you have in the field of computer science?

PARTICIPANTS

In order to explain in detail regarding the graduate school decision making process, data was collected from a group of 10 participants consisting of three major groups: 1) Individuals currently in a graduate program, 2) Individuals currently planning on enrolling in a graduate program and 3) Individuals who entered the workforce immediately. The following groups of individuals were selected to understand the different points of views when it comes to graduate school. Each individual within these groups are current or former UVA undergraduate students with a bachelor's degree in computer science. While this is the rationale for selecting these individuals as participants, the data collection analysis procedure will allow proper distinction of key similarities and differences in regards to their point of view toward graduate school.

Table 1: Demographic Data for Study Participants (Currently in process)			
Pseudonym	Gender	Age	Current Status
Alexander	Male	28	Third Year PhD Student
Brian	Male	22	Current Industry Worker
Charles	Male	31	Third Year PhD Student
Daniel	Male	22	Soon to be Master's Student
Evelyn	Female	27	Third Year PhD Student
Franklin	Male	21	Current Industry Worker
Gavin	Male	28	Second Year PhD Student
Hannah	Female	23	First Year Master Student
Iris	Female	29	Current Industry Worker

Participants consisted of six males and three females, ranging in age, focus in their studies, and in various stages of their graduate and professional careers. Demographic data for participants are shown in Table 1: Demographic Data for Study Participants. Actual names are replaced by pseudonyms to ensure anonymity of study participants.

DATA COLLECTION

Data was collected from informal conversational interviews organized by key topics to discuss different stages when preparing for graduate school. The interview begins with a basic summary of the interview, including an explanation of the logistics and purpose of the study, gathering background information about the participant's demographics, education and path since their undergraduate careers. The questions then focus on two main topics: 1) Preparation for graduate school and 2) Work experience during or after their undergraduate careers. Further information regarding topics covered and sample questions are provided in Table 2: General Outline of Interview Topics. Given the nature of an informal conversational interview, follow-up

questions regarding specific topics or statements were asked to further clarify unclear points, ask for further information and probe deeper into the thought process of individuals during their decision making process. Interviews lasted approximately one hour. Each interview was audio recorded, with a transcript produced after completing each interview.

DATA ANALYSIS

Data analysis was completed on each transcribed interview using deductive coding, meaning categories and keywords are created and highlighted during the process. These codes were noted to be referenced during each subsequent interview transcript review in order to identify repeating themes, by identifying repeating phrases or ideas. Each interview transcript review also focuses on identifying distinctions between each interview from each other. The following codes used during this analysis process are listed in Table 3: Data Analysis Codes. In order to recognize differing levels of emphasis in regards to different codes, each code is assigned a weight value between 1 and 5, with 1 representing the largest influence on the graduate school decision making process and 5 representing the least. One point to note is that the difference between weight values does not proportionally represent the importance of each code. Rather, it represents a relative ranking of each code and does not mean that different participants with same weight values placed the same amount of emphasis on specific codes.

Table 3: Data Analysis Codes

Code	Description
Family Influences	Participants indicate other family members have had an effect on their perspective of graduate school.
Research Interest	Participants indicate having an interest in a particular subject in computer science.
Immigration	Participants indicate reasons for pursuing graduate school are related to

	immigration, whether that be a visa or green card.
Utility	Participants indicated that having a graduate degree in computer science has a variety of benefits in regards to their professional careers.

RESULTS

While attempts were made to make the group of study participants as diverse as possible, including current and future graduate students, as well as current industry workers, it is important to note the lack of diversity in two major categories: 1) Gender and 2) Current graduate student status. Arguments can be made that the following result in the lack of representation of genders within the study should've been expected, as current statistics show that females within the CS field only represent 20% of the population (Cheryan et al., 2024). As such, while it is still fine to make note of the analysis made within the sections that follow, it is important to keep in mind this disparity. Another issue within the collected data is the lack of representation of different levels of graduate student status. Coincidentally, information collected by current graduate students was collected from a majority of third year PhD students. Given that the following study focuses on the reasoning behind deciding to pursue further education in graduate school, the current status of graduate students theoretically should not impact the experience and thought process that occurred before their graduate student career. However, it is important to note that it is possible that current student status may alter participants' perception of past experiences.

Motivating Values for Graduate Students

The following research question will be the main focus of this section: What factors influence a student's decision to pursue further education in graduate school? Through use of the analyzed interview transcripts with current and future graduate students, the following section summarizes the trends across the different participants, providing an insight into some potential

factors that may influence student decision and perception in regards to graduate school. Weights of the following variables, which were assigned through an analysis of the interviews with regards to metrics such as repetition, intensity and length of topic discussion during interviews. Two main variables, research interest and immigration, will be the focus of this section, with a miscellaneous section for discussion of variables that either have less of an impact or could not have a conclusion made.

Interest in Subject Matter

One commonality that came during interviews is that further education in graduate school was most likely to be pursued by students who had a genuine interest in the subject matter. A major reason that most students in recent times pursue an undergraduate degree in CS is due to the possibility to work high paying tech-based jobs. As such, these students are more likely to complete the bare minimum in order to be eligible for these jobs, which is either an undergraduate degree or certifications in different aspects of software engineering. One interesting point that was pointed out during the interview with Gavin was the change to the CS program at UVA due to the current student population expectations. During his time as a graduate teaching assistant, he mentioned that while the basis of information that the department expects professor to cover rarely changes, the difficulty of the courses can change and is often influenced the most by student interest and opinion. Figure 1 represents the following situation in a feedback loop of how each idea influences each other. With an increase in general tendency for students to pursue a CS degree in order to better their chances to work at tech companies, overall interest in the subject matter have seemed to have decreased. As a result, student satisfaction, as shown in course reviews and personal accounts shared with teaching assistants and professors, has decreased as well. This has forced some professors to fulfill the demands of students,

changing course content and lowering the difficulty to better suit the student population, resulting in a decrease in course innovation and the number of unique and interesting courses.

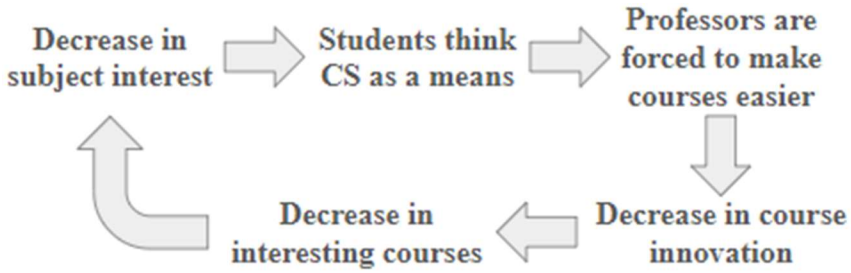

Figure 1: Feedback loop representing effects of student opinion on CS courses

Despite this, some students manage to maintain a high level of interest in CS, mostly in specific topics or theories that they have learned during the course of their education. In a means to learn more about their interest topics, students with a genuine interest in the subject matter seem to be more likely to pursue further education in graduate school. An interesting point to make is that of the five current graduate students, including both Masters and PhD students, four of them have noted that they have a genuine interest in a specific topic within the field of CS. Charles, who does research in artificial network behavior, specifically said, "...I really wanted to do that for research, … what I really loved was the weird stuff." Even if the subject is very niche, as long as the student has a genuine interest, it is more likely for them to go to graduate school to further their understanding of the topic.

Immigration

Another commonality amongst graduate student participants is that they are immigrants or they talked about immigration during their interviews. Of the six graduate student participants, four of them have noted that immigration was a strong factor when influencing their decision to pursue graduate studies. Alexander mentioned that he noticed a large presence of international students within the UVA CS department. To understand this, it's important to break down the

important factors that create these circumstances. In order to live in the United States as a non-citizen, a visa or a Permanent Resident Card, also known as a Green Card, is required for these individuals to have legal status. However, obtaining these documents as a person living outside of the US without US-citizen family members is difficult. Amongst this difficult process, student visas tend to be the most accessible for individuals, as long as their financial situations can support it. Student visas, which tend to be F1 visas, allow students to stay within the US during their time of enrollment. In other words, methods to extend their enrollment in school, such as graduate school or research programs, can be another means to stay longer in the US.

Another option for international students is applying for employment based visas, either for company-sponsored H-1B visas or by applying for Optional Practical Training (OPT) employment, extending their stay within the US under the caveat that they are employed by an eligible company for a degree related position. OPT employment is also more beneficial for STEM degree holders, as the period for stay is extended by 24 months, compared to the 12 months for non-STEM degree holders. H-1B visa holders are also eligible to apply for a Green Card after fulfilling the maximum duration of six years. Evelyn noted during the interview that, "... a faculty job after graduation… is the fastest way so far to get a green card in the United States. The premise of getting a faculty job is that you have a PhD degree." As such, while the period of stay varies from program to program, the ability to stay in the US for longer periods of time and the potential high paying tech jobs make engineering degrees, including computer science, an ideal option for those looking to live in the US.

During initial stages of this study, a few factors most likely to impact graduate school decisions were identified. However, the importance of immigration was not conceived during this time, yielding an important point to consider. With international students taking up a

surprisingly large portion of the student population, does this trend prove to be true across all universities? Identifying if other universities experience the same influx of international students or if certain universities have commonalities amongst them that make these universities more appealing to international students is something worth looking into.

Miscellaneous

While there are two other factors that were mentioned during discussion with interview participants, these factors were not placed within their designated sections for their own specific reasons. The first factor worth mentioning is the influence of family members. During discussions, both Alexander and Charles mentioned that influence from family members was a large factor when deciding to pursue an undergraduate degree. In Alexander's case, both his parents were former professors of computer science. In Charles's case, he mentioned that his sister played a major part during his high school, as his sister was part of a STEM program that he decided to pursue in her footsteps. However, most of their focus in regards to their family members were related to their decision for their undergraduate CS degree, rather than the graduate degree that they are currently pursuing and the topic of this study. As such, with the current interview results, it cannot be concluded whether or not family influences have an effect on student decisions on graduate school.

Another factor that interview participants have noted during interviews is the higher pay after graduate school. One promise that comes with completing a graduate degree is that wages for these individuals tend to be higher than those who have an undergraduate degree. The reasoning behind this is that individuals with graduate degrees are more likely to have a deeper understanding in regards to computer science, particularly for PhD students who specialize in specific topics. For example, both Alexander and Gavin mentioned that the importance of

monetary gains steadily increased over time. In the case of Alexander, he noted that while "... doing data analysis, or machine learning… that's a part that (he) enjoys, recognizing that (he's) gonna be able to make money… is a good compromise." While the joy of doing research in his particular subject matter was the reason behind why he decided to pursue graduate school in the first place, it was still a valid economic option to take in the long run. In the case of Gavin, he mentioned that while the driving factor for joining a graduate program was his passion for research, he noted a change in focus as time passed. Factors such as economic security and the ability to support a family were growing concerns, with a "80% focus on research… 20% focus on money" currently. From a different perspective, Brian, a current software engineer for a tech company, noted that the main reason behind why he decided not to go to graduate school was he prioritized the experience of working in the field and thought that graduate school "...wouldn't feel like it's going to be as useful as industry." Each individual had mentioned that monetary gains was something that they had considered at one point during their graduate studies. However, determining how large of an impact that the potential monetary gains from earning a graduate degree had on the decision to complete a graduate degree, especially given the clashing perspectives given from different interview participants, was difficult. As a result, the impact of monetary gains from a graduate degree needs to be further investigated in order to understand this better and, as such, was placed in the miscellaneous section.

Limitations and Future Work

While many of the findings derived from the interviews were important in gaining insight into understanding how different factors influence the decision making process of pursuing further education in graduate school, it is important to do further research in order to have more

conclusive evidence supporting the following claims. Current limitations in our sample size, particularly in the number of participants and the lack of Masters program students, make for an ill representation of the CS graduate student population at UVA. With a population of four PhD students, one master student and one soon-to-be graduate student, six individuals is too small of a population to be able to make solid conclusions in regards to a complex decision such as the one related to graduate school.Furthermore, a lack of diversity amongst our interview participants may contribute to a lopsided opinion in regards to grad school, particularly the perception amongst industry workers. Our current population only accounts for the opinion of two industry workers that have relatively negative attitudes towards graduate students. Rather, these individuals value the importance of industry experience over knowledge in a potentially niche topic. As such, a larger and more diverse representative population is needed in order to further increase the validity of the identified factors that influence the decision making process that students go through when deciding to pursue further education within graduate school.

Conclusion

This study attempts to understand why graduate students forgo the opportunity to work in industry by conducting interviews with current and future graduate students in order to identify major factors that can potentially impact this decision. The study was started from an intrigue to understand the anomaly that is students pursuing graduate degree programs, despite current job market trends to enter the industry immediately after completion of their undergraduate degree. Initially, pursuing graduate studies didn't seem to make economic sense, given the need to forgo lucrative careers in tech companies. However, two major factors, research interest and immigration, were found to potentially have the most impact on student perception of graduate programs and the decision to pursue a graduate degree. Despite the promise of high wages and a

great work-life balance, students pursuing graduate programs weighed their interest in the subject matter and immigration-related matters to be more heavy than the aforementioned benefits. The hope is that universities are able to use this information to potentially plan their efforts better on designing course paths that target student niches, focusing more on research or industry skills depending on the preferences of the student population. However, further research must be conducted in order to derive more conclusive insights for the following information to be used in predictive analysis of what kind of students are more likely to pursue a graduate degree.

Acknowledgements

I'd like to thank all interview participants for their efforts in contributing to the following research topic, as well for their flexibility and time commitment to schedule and participate in the following interview process.

Appendix

Table 2: General Outline of Interview Topics

Topics Covered	Sample Questions or Statements

Background
- Age/Gender/Ethnicity/Socioeconomic background
- If returner?
  - Time passed from undergrad and grad school
  - Reasoning for return
- Previous and current programs
	Can you tell me about your background?
	- Clarify certain points if not mentioned
	What were your undergrad/grad programs?
	- What was the focus of the CS department at your previous university?
	  - Was it more research focused?
	  - What was the student culture like within the program?
	  - Is there anything you noticed about other students on their focus/priorities within the CS department?
	Did you decide to enter grad school after completing your undergrad?
	- If so, what was the time frame regarding that decision?
	- How long were you considering grad school as an option?

	- (For Returners) What made you decide to return to school for a graduate degree?

Preparation for Grad School
- Decision to go to grad school
  - Advice and experiences during undergrad
  - Professors
  - Peers
  - Program stance
- Expectations for grad school
- Choosing Program
	Tell me what made you decide to enter a graduate program.
	What kind of advice/thoughts were shared with you when you made this decision?
	- Who shared that advice with you?
	- How much would you say that advice influenced your thoughts when you made the decision on UVA's grad program?
	Did you experience anything during your undergrad career that influenced your stance on grad school?
	- Did you have any mentors/colleagues that you looked up?
	- How much and in what way would you say that the people around you influenced your decision?
	- Did you have some kind of expectation towards grad school or the program at UVA?
	What made you decide on UVA's CS program?
	- What are some factors that you considered when choosing the program?
	- Did you have any scholarships/sponsorships that made UVA's program more enticing?

Work Experience (Career/Internship)
- Description of experience
  - Key influences/Mentors
  - How does work experience change stance?
- Potential options
	What were some of your other options if you didn't decide to go to grad school?
	- Do you have any work/research experience before starting graduate school?
	What kind of work experience do you have?
	- Company (Industry)
	- Type of work/responsibilities
	- Team composition (Peers, mentors, etc…)
	- Do you think your work experience influences how/what you think about a Graduate degree?

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