Comparing Student and Recruiter Evaluations of Computer Science Resumes

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Abstract—Contribution: **This study identifies which entry-level computer science (CS) resume items are most important and compares the ratings of student and recruiter participants to investigate the accuracy of student beliefs. To the authors' knowledge, this study is the first to analyze the extent to which CS students understand the resume screening process. The results of this have consequences for students in their own resume development.**

Background: **Although prior research studies the importance of different resume items generally, little is known about resumes for CS majors, which may contain distinctive sections. Less still is known about whether students understand the resume screening process.**

Research Questions: **Which items on entry-level CS resumes most directly influence screening decisions? What gaps exist between CS students' and recruiters' perceptions of resume items? Does the disparity in expertise between students and recruiters contribute to differences in resume screening?**

Methodology: **197 recruiters and 73 CS undergraduates screened randomized CS resumes. Data were analyzed using ordinary least-squares regression with interactions.**

Findings: **Students were more likely than recruiters to move resumes to the next level and spent about 7 s less than recruiters when screening resumes. Though students correctly assessed the value of most resume items, they significantly overestimated the value of prior work experience such as internships.**

Index Terms—**Computer science (CS) education, resumes, student experiments.**

I. Introduction

RESUME screening is the initial step of the job selection process and often serves as the first point of contact between job seekers and employers [1], [2], [3]. To organizations, resumes provide an economical means of identifying qualified candidates before investing in more expensive methods of selection such as interviews [4]. To applicants, resumes play a key role in establishing first impressions, maintaining candidacy in the selection process, and gaining invitations to interview [1], [3], [5].

The importance of resumes and impressions formed from their review extends beyond the initial screening process. The initial application screening also has an impact on post-interview evaluations [5]. Assessments following interviews are especially important because hiring recommendations from interviewers influence organizational hiring decisions [6].

Candidates are often selected to be interviewed because of the credentials on their application and the impressions formed as a result of the information presented [7]. As such, it is important to establish whether or not students understand what constitutes an attractive computer science (CS) resume. Specifically, knowing the resume items that lead to the greatest improvement in resume quality should facilitate students' ability to design their own resumes.

Previous studies in CS do not address resume construction for recent graduates. Instead, these studies largely focus on which skills are requested by companies in the industry. Though knowing which skills are most desirable is important, so too is knowing how best to convey these skills through a properly constructed resume. A large body of literature does provide general resume advice across various specialities. However, while the majority of these previous studies draw conclusions from surveys, the present study simulates the resume screening process. The benefit of this approach is that it allows us to directly identify which resume items carry the most weight in recruiters' hiring decisions and reveals any misunderstandings students have regarding the importance of these items.

II. Expertise

Differences in resume screening experience between students and recruiters likely account for discrepancies in resume screening decisions. In personnel selection, recruiters are relative experts compared to students. Here, an expert is defined as a member of the more knowledgeable group and a novice as a member of the less knowledgeable group [8]. Experts possess more domain-specific knowledge and organize this knowledge into patterns that enable superior performance in domain-related tasks [9]. An expert is more successful at selecting appropriate strategies and is able to identify the most relevant information to make decisions [8], [10]. Past studies in personnel selection reveal that students incorporate more irrelevant

aspects in screening decisions than do recruiters [11], [12]. Additionally, experts consider resume items indicative of future organizational performance as more important than novices [11], [13].

Students are consistently more lenient and give higher overall ratings to resumes than do recruiters [14], [15], [16], [17]. The frequency and replaceability of this finding suggest an underlying root cause. To explain this phenomenon, several hypotheses have been proposed. Early theories have suggested that underlying differences in category width between recruiters may explain differences in selection decisions between recruiters [18]. Category width refers to the inclusivity of a category according to an individual, leading to differences in what a person considers to be a good representative of that category. For instance, a broader definition of the category "ideal candidate" offers one potential explanation for the leniency shown by student reviewers. A similar theory is that students and recruiters define different cutoff points when assessing the acceptability of a candidate [15]. Others posit that students are more likely to give higher ratings to fellow students because they are like themselves [16]. Students may also not fully understand the degree of competence expected of them from the workforce [17]. As such, it is likely that students will move more resumes to the next hiring level than will recruiters.

The amount of time recruiters spend screening resumes has not been extensively researched. Resume screening is a highly idiosyncratic practice [19], which may explain the lack of research. An early study found that recruiters for accounting, banking, sales, office administration, management training, and management information systems (MIS) spent between 30 and 120 s screening each resume [20]. A more recent study involving human resources and business graduate students spent an average of 16 s when reviewing an administrative assistant resume [21]. Experts are able to solve problems faster because they use the best strategies [8], so it seems likely that recruiters will spend less time screening resumes than students.

III. Common Resume Sections

Resume research indicates that most resume items fall under the categories of academic qualifications, work experience, or extracurricular activities [3], [14], [22], [23]. Recruiters use information within these categories to form impressions regarding applicants' abilities, motivation, personality, and fit [4], [22], [24], [25], [26], [27]. The extent to which a resume item predicts future job performance corresponds to the importance, or weight, allocated to that item in selection decisions [11]. Therefore, job seekers must be aware of which items have the greatest influence on resume screening outcomes. Space on a resume is limited, so students must understand recruiters' perceptions of resume items to determine which qualifications merit inclusion.

A. Academic Qualifications

Ample evidence supports the inclusion of GPA on entry-level resumes across all majors [1], [20], [28], [29]. Although listing GPA is more beneficial to candidates with high GPA,

the inclusion of GPA on the resume regardless of its quality was found to be more favorable than withholding the information [1], [28]. In general, GPA is more important for entry-level workers than for experienced workers [30] and GPA loses its predictive value over time following graduation [31]. GPA is often used by organizations as a screening tool where a minimum or cutoff GPA is set to reduce the applicant pool and simplify the process of selecting candidates to interview [32], [33], [34]. Though common, this practice is not universal, suggesting that the precise usage of GPA in screening decisions may be dependent on the recruiter [35].

Past studies of students and recruiters in business-related occupations, such as accounting, marketing, and managerial work, have contradictory findings regarding GPA. Students either underestimated the significance of GPA [36], [37] or had a realistic understanding of its importance as compared to recruiters [38]. In one study of accounting students and recruiters, students were less harsh when reviewing candidates with low or average GPA [14]. However, a more recent study of marketing graduates reported that students overestimated the importance of GPA [39].

Academics are regarded as highly important for majors within the computing field [40]. Although recruiters are cautioned against relying on GPA for screening information technology (IT) resumes [34], a high GPA is of moderate importance when hiring for IT positions [41]. Students in majors within the computing field recognize that GPA is a factor in the hiring process; when hiring for a fictional software development position, CS undergraduates were more likely to recommend the applicants with high GPAs than low GPAs [42]. While students recognize that GPA is often used in screening decisions in the computing field, the extent to which students believe GPA influences application quality may differ from recruiters. This current study tests if GPA is considered when hiring CS majors and whether CS students correctly valuate GPA.

Support for the inclusion of relevant coursework is mixed. A survey of Fortune 500 personnel administrators revealed that listing courses was not important on the resume [28]. However, a later survey of 64 business professionals reported that resumes listing relevant coursework received more interviews [1] and a separate study identified job-related coursework as among the most frequently mentioned determinants of applicant fit [24]. This study also tests the effects of listing relevant coursework for CS majors specifically.

B. Work Experience

The inclusion of previous work experience on resumes is also strongly supported by [20], [28], [29], and [43]. One metastudy identified work experience as the highest correlated measure in predicting future job performance [44]. For students applying for entry-level positions, work experience is often in the form of internships. Prior to graduation, having at least one past internship improves a student's chances of obtaining other, future internships [45]. Following graduation, internship experience increases the probability of being invited to interview [46], [47]. One study of business-related industries

found that previous internship experience improved the probability of an interview invitation by 14.3% [46]. A separate study across all industries reported an only marginally smaller 12.6% improvement to interview chances for applicants with past internship experience [47]. Internships may improve a prospective hires' chances because of the job-related technical and nontechnical skills that are developed as part of the experience [48], [49]. Although relevant experience results in more positive applicant perceptions [50], even irrelevant work experience may merit inclusion in the resume [29], [51].

The only studies found in the literature review that directly compare student and recruiter perceptions of work experience involve business-related majors. In these studies, students either overestimated the importance of work experience [14] or correctly assessed its value [36], [38] as compared to recruiters. It is difficult to draw a conclusion from these earlier studies because they did not explicitly use internships to represent work experience. More recently, a study of marketing majors found that students significantly overestimated the importance of internships on resumes compared to either recruiters or faculty [39].

In a study of desirable qualifications for entry-level software application developers, previous internship experience was among the most desirable qualifications for prospective candidates and was only becoming more important over time [52]. In support of this finding, a later study of job postings identified previous work experience as one of the most frequently requested competencies for CS graduates [53]. Another identified relevant work experience, irrelevant work experience, and internships/co-ops as important for entry-level IT workers [41]. Students in the computing field recognize the importance of previous work experience in hiring decisions; one study reported that 60% of participating students considered experience when hiring for a fictitious software development position [42]. In this study, both the extent internships and other work experiences are factored into the resume screening process for entry-level CS recruiters and whether students are able to identify the role that internship experience plays on entry-level resumes are tested.

C. Extracurricular Activities

Opinions on whether or not to include extracurriculars on resumes are mixed, ranging from inconsequential [28] to being of moderate importance [3], [20]. Recruiters favorably view leadership positions in extracurriculars and career-related societies [2]. For business, sales, and accounting majors, applicant employability is higher when the extracurriculars are not related to fraternities or sororities [22], [27]. Honor societies with Greek titles received a similar treatment to fraternities and sororities from recruiters, implying that students may need to provide a description to help recruiters distinguish between honor societies and social organizations on resumes [27]. Extracurriculars may add value to resumes because they are associated with higher interpersonal skills [22], [23], [54] and higher levels of conscientiousness and extraversion [55]. However, there is minimal evidence that extracurricular activities are desirable for entry-level computing positions. Of the seven given hiring criteria for hiring information systems (IS) employees, leadership

through extracurriculars was the lowest rated hiring criteria by recruiters [56]. In a more recent study, extracurricular activities were the lowest rated skill, trait, or knowledge area considered somewhat important for entry-level IT majors [41].

Studies comparing student and recruiter perceptions of extracurriculars are limited to majors outside of CS. In these studies, students either overestimated [39] or correctly assessed the importance of extracurriculars [38]. Only one of these studies differentiated between Greek societies and professional organizations. However, students overestimated the importance of the extracurricular in either case [36]. In a study involving non-Greek undergraduates, Greek undergraduates, Greek Alumni, and hiring personnel, the non-Greek undergraduates were the least likely group to agree with positive Greek stereotypes and most likely to agree with negative stereotypes [57]. The present study divides extracurriculars into clubs and Greek societies and tests the influence that each has on the resume screening process.

IV. COMPUTER SCIENCE-SPECIFIC RESUME SECTIONS

For entry-level CS students, additional sections to list skills and describe projects may also warrant inclusion.

A. Skills

Although studies support the inclusion of skills and special aptitudes on the resume [43], [58], there is less support for dedicating a section on the resume to skills. Despite this lack, the frequency with which technical and nontechnical skills are mentioned in the CS literature suggests these skills need to be included in some form on the resume. The idea of creating a separate section to list skills may be limited to more technical occupations.

The majority of research for computer-related majors, such as IS, IT, and CS makes references to technical and nontechnical skills, alternatively referred to as hard and soft skills [41], [52], [53], [59], [60], [61], [62], [63], [64]. Although technical skills were universally seen as important by recruiters, they were often ranked lower in importance as compared to nontechnical skills [41], [61], [62], [63]. The superior importance of nontechnical skills was not unanimous, however with some studies finding the opposite to be true [52], [60]. The previous studies all found that both technical and nontechnical skills were important in the computing field.

Out of all the technical skills, programming fundamentals and programming languages were the most frequently requested [52], [60]. More often, technical skills are sufficient in new graduates [65]; however, a lack of project experience and the inability to properly utilize software tools have been documented as some of the more common insufficiencies of recent CS graduates [66], [67].

Nontechnical skills that fall under categories, such as communication, teamwork, problem solving, and time management, have become a point of emphasis across all industries [68]. Three of these skill categories—communication, teamwork, and problem solving—were also identified as essential by CS recruiters. The only notable difference was that critical thinking skills were mentioned more often than time management skills [41], [52], [59], [62], [63], [64], [69].

Recent CS professionals are more commonly reported to have deficiencies in nontechnical areas, specifically concerning verbal and written communication skills [65], [66], [67]. These preparation gaps likely exist because of differences between coding assignments within academia, and those performed in a professional setting [70].

In a study where students considered applications for a fictional software developer position, CS undergraduates most frequently considered technical skills when making hiring decisions [42]. Despite technical skills being the largest factor in the study, the majority of students also agreed that soft skills were still vital qualities for candidates to possess [42]. Similarly, an earlier survey of IT students found that students were able to recognize technical skills as important, but not sufficient in themselves [71]. One survey of IS majors compared student and recruiter perceptions of skill requirements. Interestingly, students underestimated the importance of nearly every nontechnical and technical skill category, implying there is a significant perception gap between computing professionals and students [61]. Despite this finding, undergraduates generally understand the importance of nontechnical skills [59], [61], [69] although students significantly underestimate the importance of problem-solving ability [59]. Students and recruiters differ more regarding technical skills with students underestimating their importance [59], [61]. The current study tests both the influence of technical and nontechnical skills on recruiters' resume screening decisions and the ability of students to assess the role these skills play in the resume screening process.

B. Projects

Compared to other established resume sections, the projects section of the CS resume may be the most niche. CS majors are encouraged to work on projects in part because they facilitate the development of soft skills [42], [72]. In the eyes of recruiters, software projects provide insights on the teamwork abilities and critical thinking skills of a candidate [62]. Software projects completed outside of regular coursework are considered especially valuable, because they convey motivation [63].

CS students also recognize the importance of projects in their education. Students often cited projects as a means of developing teamwork abilities and communication skills [73] and preferred project-based learning courses over those with only traditional lectures and exams [74]. Although these findings suggest that students recognize the importance of projects to their professional development, they offer little help in predicting how students believe projects are factored into an application. This study seeks to establish whether or not projects listed on resumes contribute to the success of resume screenings and if students are accurate in their beliefs.

V. METHODOLOGY

A. Participants

Students participating in the study were recruited through emails and short recruitment speeches at the beginning of CS classes. All students that participated in the study were

TABLE I
DEMOGRAPHICS AND OUTCOMES OF RESUME REVIEWERS

Category	Response	Recruiter	Student	Sig Dif
Gender	Male	54.31%	84.93%	Yes
	Female	44.67%	15.07%	Yes
	Other	1.02%	0%	Yes
Race	White	80.02%	54.79%	Yes
	Asian	7.61%	31.51%	Yes
	Black	7.10%	5.48%	Yes
	Native American/Hawaiian Islander	1.02%	2.74%	Yes
	Other/Prefer Not to Say	4.06%	5.48%	No
Ethnicity	Hispanic/Latino	17.3%	21.9%	Yes
	Not Hispanic/Latino	82.5%	78.1%	Yes
Outcome	Percent Moved to Next	44.7%	52.1%	Yes
	Resume Screening Time	19.37 sec	12.17 sec	Yes
Total Participants:		197	73	

All results are two-sided two sample t tests between the number of each category for recruiter and students. Significance is marked at the .05 level.

TABLE II
RECRUITER INDUSTRIES

Industry	Freq	%
Computer systems design & services	46	23.5
Finance, insurance, real estate, & rental leasing	28	14.3
Professional, scientific, & professional services	22	11.2
Industrial & miscellaneous chemicals and/or petroleum	14	7.1
Public administration	13	6.6
Information & communications	11	5.6
Business support services including employment support services	9	4.6
Administrative & other support services	6	3.1
Educational, health, & social services	6	3.1
Other Industries	41	20.9

CS majors. In total, 77 undergraduates were recruited for the study. Recruiters were recruited at STEM career fairs on college campuses, at industry fairs, and at employers' offices. In all, 221 recruiters participated in the study. All recruiters in the study hire software engineers and had prior experience evaluating CS resumes.

Some resume items were slightly different in the two studies. To preserve the integrity of the resumes being compared between studies, a subset of comparable resumes from each study was used for statistical analysis. This limited the usable participants to 73 CS undergraduates and 197 recruiters. Demographics information for the remaining participants is shown in Table I. Recruiters were from a wide variety of industries as shown in Table II (full list available from authors on request). The most common industry was computer systems design and services, which accounted for nearly a quarter of the participating recruiters ($n = 46$).

B. Experiment

The experiment was on two separate populations. In the first experiment, students completed the study in empty study spaces and classrooms and utilized Tobii X2-60 eye-trackers. In the second experiment, recruiters completed the study in private booths at career fairs and various office spaces and used Tobii Spectrum eye-trackers. All participants signed a consent form prior to participation in the study. All participants were

informed that they could drop out at any point without penalty and were asked if they had any questions prior to proceeding with the study. The eye-trackers were then calibrated to the participant. Next, participants were both given verbal instructions and written instructions on the screen. Participants were first presented five example resumes as a means of orienting themselves to the task. They were then shown 30 resumes to screen at their own pace. For each resume, participants had the option to select a checkbox to indicate whether or not they would move the resume to the next level. After rating all the resumes, participants were asked what job they were thinking of while reviewing the resumes. Then resumes were brought back in a second round. If students had moved a resume to the next level, they were asked to answer three questions about the resumes. Recruiters were asked three questions about each resume regardless of whether or not they moved a resume to the next level: 1) Please rate the quality or "hireability" of the previous candidate. 2) What type of position do you think this candidate will most likely end up in? and 3) What starting salary would you guess that this candidate would receive?

After the screening process was completed, participants answered a short demographics survey on the computer. The study itself was self-paced and completed using a mouse and keyboard. Students were given \$20 and recruiters were given \$50 for their participation in the study. The data collected were then de-identified to ensure the anonymity of the participants.

C. Resumes

All resumes were unique and randomly generated using techniques as described in [75]. Resumes in both experiments used five primary sections. At the top of resumes were the academic qualifications; this section contained information about an applicant's college, degree, GPA, and coursework. Coursework was not always listed on the resume, but college, degree, and GPA appeared on every resume. College and degree were each held constant. GPA ranged from 2.2 to 4.0 with an average GPA of 3.3 on resumes. Below the academic qualifications section were the work experience and projects sections. These sections contained between 0–4 different internships (average 2) and 0–3 projects (average 1), respectively. The next section, "Membership," contained extracurricular activities, such as club involvement and any fraternity or sorority involvement. The last section, "Skills," listed between 0 and 15 technical and nontechnical skills.

D. Equation

An ordinary least squares (OLS) in a linear probability model (LPM) was used to predict the likelihood that a participant will choose to move a resume to "the next level," based on the following resume inputs. (Probit estimations provide similar results; OLS is provided for convenience of interpretation.) All calculations were performed using Stata v.16, a statistical software package.

$$\text{Move To Next} = \beta_1 GPA_{r,p} + \beta_2 AnyCourselist_{r,p} + \beta_3 AnyJob_{r,p} + \beta_4 AnyFratSor_{r,p} + \beta_5 AnyClub_{r,p} + \beta_6 AnyTechSkill_{r,p} + \beta_7 AnyNontechSkill_{r,p} + \beta_8 AnyProject_{r,p} + \epsilon_{r,p}.$$

TABLE III
RESUME ITEM WEIGHTS

Variable	(1) Recruiters	(2) Students	(3) Sig Dif
GPA	0.285*** (0.0489)	0.266*** (0.0493)	No
Courses	0.0273 (0.0312)	0.0585 (0.0436)	No
Work Experience	0.302*** (0.0565)	0.507*** (0.0816)	Yes
Fraternity/Sorority	0.0828* (0.0318)	-0.0292 (0.0565)	No
Clubs	0.0798** (0.0356)	0.0566 (0.0614)	No
Technical Skills	0.199*** (0.0320)	0.145*** (0.0491)	No
Non-Technical Skills	-0.0338 (0.0343)	-0.0272 (0.0486)	No
Projects	0.177*** (0.0329)	0.260*** (0.0514)	No
Constants	-1.112*** (0.111)	-1.087*** (0.154)	
Observations	860	324	
R-squared	0.183	0.247	

Robust standard errors in parenthesis
*** p<0.01, ** p<0.05, *p<0.1
Note: Sig Dif indicates a significant difference between the Recruiter and Student results

Move To Next is a binary variable indicating that the participants believe the resume should be moved to the next level in the screening process, as defined by the participant. GPA is a categorical variable spanning from 2.2 to 4.0. AnyCourselist is a 0/1 variable indicating whether or not the resume provides a list of courses in the education section. AnyJob is a 0/1 variable indicating whether or not the resume lists work experience. In some cases, AnyJob was further separated into 0/1 variables for retail experience (e.g., cashier), irrelevant internships (e.g., Fine Arts Summer Intern), academic internships (e.g., REU Internship), technician experience (e.g., Field Service Technician), and software experience (e.g., Programming Intern) to determine the effects of different types of work experience. AnyFratSor is a 0/1 variable indicating whether or not the resume lists at least one fraternity or sorority. AnyClub is a 0/1 variable indicating whether or not the resume lists at least one club membership. AnyTechSkill is a 0/1 variable indicating whether or not the resume lists at least one technical skill. Technical skills included programming languages such as Java, as well as software such as the game engine Unity. AnyNontechSkill is a 0/1 variable indicating whether or not the resume lists at least one nontechnical skill. Nontechnical skills included listing skills such as "hardworking" and being a "quick learner." AnyProject is a 0/1 variable indicating whether or not the resume lists a project. Some instances within categories appeared too infrequently to run a regression on all the individual items, so the majority of items were grouped as 0/1 variables.

VI. RESULTS

The resume reviewer outcomes are shown at the bottom of Table I. Students were more lenient on screening decisions
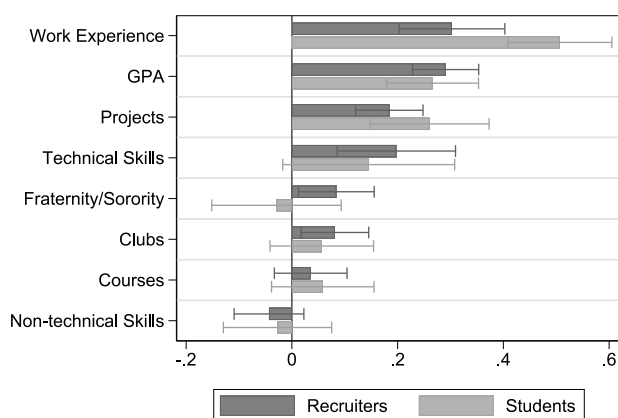
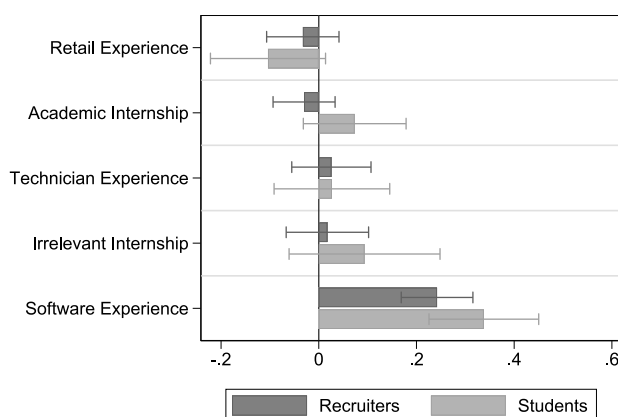Fig. 1.   Comparing preferences of recruiters and students.

Fig. 2.   Comparing work experience.

and were 7.4% points more likely to move a resume to the next level than recruiters. On average, students also spent 7.2 s less reviewing each resume than did recruiters.

Table III displays the correlation of each resume item to being moved to the next level. A visual comparison of the results can be seen in Fig. 1.

Each point in GPA improved the probability of being moved to the next level by 28.5% points and 26.6% points for recruiters and students, respectively (both significant at the 1% level). The addition of relevant courses did not significantly correlate to either recruiter or student screening decisions. Relevant courses did have a weakly positive correlation for both recruiters and students, improving the probability of being moved to the next level by 3.43% and 4.86% points for recruiters and students, respectively.

The importance of work experience, though significantly overestimated by students ($p < 0.05$), was still acknowledged as a vital component of resumes by recruiters. Having prior work experience increased the probability of being moved to the next level by 30.2% points for recruiters (significant at the 1% level) and 50.7% points for students (significant at the 1% level). This difference between recruiters and students is itself significant at the 5% level. Work experience was the only resume item in the study that students and recruiters evaluated significantly differently from each other.

As shown in Fig. 2, the work experience category was then partitioned to determine which types of work experiences were valued by recruiters and students. Having an internship focused on software experience in industry increased the probability of being moved to the next level by recruiters and students by 23.8% points and 33.8% points at the 5% significance level. The difference between recruiters and students was not significant for software experience. Retail experience and academic internship experience had weakly negative effects on the probability of moving candidates to the next level for both students and recruiters, though this finding was not significant. Students, however, had a nonsignificant, positive association with academic internships. Although the difference between recruiters and students was not significant for academic internship experience, the difference in association implies a knowledge gap may exist. Technician experience as well as irrelevant internship experience (such as a Pathology Intern position) both had an insignificant, but a positive association with being moved to the next level for both recruiters and students. The difference between recruiters and students was not significant for either technician experience or irrelevant experience.

Extracurricular activities, including both club and fraternity/sorority involvement, increased recruiters' probability of moving candidates to the next level by 7.98% and 8.28% points and were significant at the 5% and 10% significance level, respectively. However, extracurricular activities were not significantly correlated with students' screening decisions. Clubs improved the probability of a student moving a resume to the next level by 4.91% points. Listing a fraternity or sorority had a weakly negative correlation for students, decreasing the probability of being moved to the next level by 2.92% points. Despite this, the correlation between extracurricular activities and screening decisions was not significantly different between students and recruiters.

Listing technical skills increased the probability of being moved to the next level by 19.9% points for recruiters and 14.5% points for students (both significant at the 1% level). Listing nontechnical skills had a nonsignificant, but weakly negative relationship with screening decisions for both recruiters and students, reducing the probability of being moved to the next level by 3.38% points for recruiters and 2.72% points for students.

The presence of at least one project improved the probability of being moved to the next level by 17.7% points for recruiters (significant at the 1% level) and 26.0% points for students (significant at the 1% level). Projects were also further divided to determine if a specific formatting or type of project yielded better results for students. These additional categories included whether or not a link was provided for the project, if the software/language used was mentioned, if the project itself was a game, if the project was completed individually or in a team, and if the project was a personal project or part of coursework. In each of these cases, projects were significant for recruiters. Compared to professionals, students were 16.7% points more likely to move resumes containing individual projects to the next level than those done in a team. In all other cases, students and recruiters rated projects similarly.

VII. Discussion

Students were more lenient when reviewing entry-level resumes than were recruiters. This finding is consistent with past literature. Less clear is the precise reason as to why this phenomenon occurs. The differences between recruiters and students can be partially attributed to students improperly weighting various resume items. However, internships were the only resume item evaluated significantly differently between students and recruiters. This implies that the leniency shown by students in the experiment is partially attributable to the students placing too much emphasis on internships.

Contrary to expectations, students spent significantly less time than recruiters reviewing each resume. While this result is unexpected, it is not entirely unprecedented. A study comparing expert engineers and engineering students reported that experts spent significantly more time in each stage of the design process than the students [76]. Novices completing the task faster was attributed to not fully understanding the complexity of the problem and did not result in superior task performance [76]. Similarly, in this study, the students likely did not fully understand how to screen resumes. Given that experts are more likely to select appropriate strategies [8], the discrepancy in resume screening time suggests that students utilized a fundamentally different screening strategy than did recruiters. Part of this difference may also be attributable to the different evaluations of internships. Students assigning too much weight to the presence or absence of at least one internship may have simplified their resume screening. Experts likely considered a more holistic view of candidates and gathered more information before reaching a decision.

Work experience was the only resume item treated significantly differently by recruiter and students. This finding is encouraging, because it suggests that students have a reasonably solid grasp of how each resume item contributes to the overall quality of their resume. Of the different types of the work experience listed on resumes, only software experience in the industry significantly improved the likelihood of being moved on to the next level. This study also suggests that recruiters do not place much value in irrelevant internship and work experiences, which contrasts with existing research [29], [41], [51]. While the difference is not significant, students appear to overestimate the value of academic and irrelevant internship experience compared to recruiters.

Work experience, GPA, technical skills, and projects were associated with the highest increases in the probability of being moved to the next level. These four resume items should likely be included on all entry-level CS resumes. Of particular note is the presence of the technical skill and project categories. Whereas internships and GPA are staples of entry-level resumes, technical skills and projects have not been as firmly established by resume literature. Explicitly listing technical skills and projects may be limited to CS resumes, but the results support the inclusion of these items. Furthermore, recruiters did not differentiate between the types of projects listed. This suggests that any relevant project may be worthy of inclusion on undergraduate CS resumes.

Extracurricular activities, such as clubs, fraternities, and sororities, led to smaller increases in the probability of being moved to the next level than the previously mentioned resume items but were still significant. Extracurricular activities likely only merit inclusion on entry-level CS resumes if there is space on the resume after accommodating other resume items. The only two resume items tested that were not correlated with screening decisions were relevant courses and listing nontechnical skills. Based on these results, courses and nontechnical skills could be left off of entry-level CS resumes in favor of other, more desirable qualifications. Nontechnical skills were the only resume information that actually lowered the probability of being moved to the next level. While this correlation was insignificant, explicitly listing nontechnical skills on resumes should likely be avoided by CS students. This finding is notable because nontechnical skills are considered desirable by CS employers. However, specifically mentioning nontechnical skills does not actually convey the presence of said skills. At best, listing nontechnical skills removes space that could better be allocated to other resume items that contribute more to the quality of the application.

This study is not without its limitations. For instance, the students were all undergraduates from a large R1 southwestern university and may not properly model responses from students of other colleges. The recruiters were also primarily located in the southwest and may not reflect the responses of recruiters in other parts of the country. Additionally, the majority of variables tested in the study were binary. These variables only denote when any of something appears on the resume and did not differentiate between one internship or four appearing on a resume.

Though students showed a high level of understanding regarding the importance of resume items, this study suggests that students do not fully grasp what constitutes a quality CS resume. The findings of this study do not necessarily indicate that their own resumes are poorly constructed, but it does reveal a disconnect between recent CS graduates and industry.

VIII. Recommendations

There are a few possible ways educational staff might address any misunderstandings students have regarding their resumes. First, resume writing skill workshops can be effective in improving the quality of resumes [77]. As such, providing resume workshops for students might be an effective way to clarify industry resume expectations.

Additionally, despite its importance to acquiring a job in the industry, the ability to write an effective resume is not a skill typically addressed within CS coursework [78]. Even the most recently created curriculum guide for CS only lists one course (professional development seminar) that takes resume writing into consideration [79]. Professional development courses such as this may warrant additional emphasis in the CS curriculum to minimize student knowledge gaps of industry expectations and hone relevant industry skills such as resume writing.

Within a resume workshop or professional development course, educational organization staff would be recommended to provide the following suggestions to students.

1) Work experience is important, but likely not as important as students think.

2) Irrelevant internships and even relevant academic positions may not significantly improve chances of being moved to the next level of the hiring process. Even so, listing any work experience is better than no experience.
3) GPA is important for entry-level positions, the higher the better.
4) Specifically mention the software, programming languages, and frameworks with which applicants are familiar.
5) Projects are worth including and may compensate for a lack of work experience.
6) Extracurriculars, such as club and fraternity/sorority involvement, may be worth including.
7) Relevant coursework may be used if space permits, but otherwise should be left out in favor of other resume items.
8) Listing soft skills on resumes does not convey their presence.

IX. Conclusion

CS is a fiercely competitive field wherein the majority of applicants for CS positions are not invited to interview [80]. Difficulty in obtaining interviews is likely due in part to either insufficient credentials or a poor presentation of those credentials on the application. It is important for those trying to enter the field to understand what makes an attractive CS resume.

This study revealed that while both students and recruiters agreed that work experience such as internships was important to application quality, students significantly overestimated the value added to an application by the presence of work experience. While the value added by other resume items was generally understood by students, students were also overly optimistic on the likelihood for a resume to be moved on to the next level of the hiring process. This finding in conjunction with students spending significantly less time screening each resume suggests that some knowledge gaps exist between students and recruiters. To address these knowledge gaps, students should be properly informed on which resume items are most deserving of inclusion.

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