

Analyzing ranking strategies to characterize competition in the co-operative education job market

SHIVANGI CHOPRA¹

LUKASZ GOLAB

University of Waterloo, Waterloo, Canada

Co-operative education is a form of work-integrated learning that includes academic study and paid work experience. This provides new learning opportunities for students and a talent pipeline for employers, but also requires participation in a competitive job market. This paper studies competition through a unique dataset from a large North American co-operative program, in which students and employers rank each other after a round of interviews, then a matching algorithm assigns students to jobs based on the ranks, and finally, they evaluate each other at the end of the work term. The results suggest that less experienced students and small employers are more strongly affected by competition and consider more options in their rankings, whereas senior students and large employers often only identify their top choice. Additionally, competition appears to affect satisfaction since students and employers give higher work term evaluations when matched with their top choice.

Keywords: Co-operative education, work-integrated learning, ranking, competition

Co-operative (co-op) education is a form of work-integrated learning that includes both academic study terms and paid work experience, referred to as co-op placements, work terms, or internships. Engineering co-op programs were introduced in North America in 1906 (Haddara & Skanes, 2007). Since then, co-op education has been adopted by many disciplines worldwide, with at least 116 institutions offering co-op programs in Canada alone (CEWIL, 2021).

Prior work examined the benefits of co-op education from the perspective of three main stakeholders: employers, educational institutions, and students (Haddara & Skanes, 2007; Thiel & Hartley, 1997). Co-op programs serve as a talent pipeline and a recruiting tool for employers (Chopra et al., 2018; Haddara & Skanes, 2007; Toulis & Golab, 2017). Research focuses on studying employers' expectations and aligning graduate competencies with employer needs (Coll et al., 2002; Chopra & Golab, 2018). From the institution's perspective, co-op programs serve as a tool for outreach and recruitment (Anderson et al., 2012; Haddara & Skanes, 2007). Co-op programs help institutions enhance relationships with industry and align curricula to job market needs (Chopra & Golab, 2018; Haddara & Skanes, 2007). Finally, co-op programs provide new learning opportunities for students and prepare them for the real world (Haddara & Skanes, 2007; Thiel & Hartley, 1997). While most research focuses on the impact of co-op on students' grades, skills, career planning, and career growth (Haddara & Skanes, 2007; Thiel & Hartley, 1997), some studies investigate competition for co-op placements and the gender differences observed in the process (Chopra et al., 2019, 2020; Jiang & Golab, 2016; Jiang et al., 2015; Toulis & Golab, 2017). In addition, recent work reports that the competition related to interviewing for and securing co-op placements is a source of stress for students (Drewery et al., 2019; Parsa & Golab, 2020). Motivated by these findings, this paper takes a closer look at the competition in co-operative education and its effects on satisfaction.

This study is based on a unique dataset from a large North American undergraduate co-operative program. In this program, the co-op employment process proceeds as follows. Employers post job advertisements, students submit applications, and employers select students they wish to interview.

¹ Corresponding author: Shivangi Chopra, s9chopra@uwaterloo.ca

After a round of interviews, students and employers rank each other. A matching algorithm then assigns students to jobs based on the ranks, with the goal of minimizing the sum of the student and employer ranks. For example, if the employer offering job A ranks student B one and vice versa, then the algorithm is guaranteed to assign job A to student B. In some cases, however, students and employers may be matched with their second or third choices, or not be matched at all. Finally, students and employers evaluate each other at the end of the work term.

One way to characterize competition in such a process is to identify job postings that receive the most applications or students who receive the most interviews or top ranks. However, even entry-level or less desirable job postings may receive many applications (mainly from junior students) and even students with little work experience may receive many interviews (mainly for entry-level jobs). Instead, this study uses the ranking step of the co-op employment process as a novel way to characterize competition. The following research questions are investigated:

1. Do ranking strategies used by students and employers reflect the level of competition they face? For example, an employer who is confident in their ability to attract top students may rank their preferred student one and not rank any other students as backup options. On the other hand, a less confident employer may rank multiple students. Similarly, students who are not confident in being matched with their preferred employer may give top ranks to multiple employers as a way to maximize their chances of finding any co-op job.
2. Does competition appear to affect satisfaction? Are students and employers more satisfied if they are matched with their top-ranked choices?

To answer these questions, this paper analyzes ranking and evaluation data from over 7,000 undergraduate students and 4,500 employers participating in the job matching process in three semesters, from September 2015 to August 2016. The first question is answered by mining frequent ranking patterns and identifying representative attributes of students and employers that use these patterns. To answer the second question, the average student and employer evaluation scores are compared for two groups: those who matched with their first choice versus those who matched with a backup choice. Permission for this secondary data analysis was granted by the university's office of research ethics (application number 42062).

In general, labor market competition has been studied from several angles, including matching resumes to job postings (Qin et al., 2018; Zhu et al., 2018). Specifically, there has been work on clustering co-op students and co-op job opportunities, suggesting that junior students compete with each other for entry-level jobs and senior students compete with each other for more advanced positions (Chopra & Golab, 2018; Toulis & Golab, 2017). To the best of the authors' knowledge, this is the first work to characterize competition based on student and employer rankings in a co-op process. Access to these unique data provides data-driven insights into competition in co-operative education that can help manage students' and employers' expectations and improve their satisfaction.

The remainder of this paper is organized as follows: the section Related Work summarizes prior work on analyzing competition in co-op; Data and Methods discusses the process that generates the data, the dataset, and the methodology; sections Employer Rankings and Student Rankings analyze employers' and students' ranking strategies, respectively; section Discussion discusses the findings and their implications for practitioners and researchers; and section Conclusions concludes the paper with directions for future work.

RELATED WORK

In terms of competition for co-op jobs, previous work studied clusters of students who interview for the same jobs and clusters of employers who interview the same students (Jiang & Golab, 2016; Toulis & Golab, 2017). Distinct clusters were found, suggesting that junior students compete with each other for entry-level jobs and senior students compete with each other for more advanced positions. Additionally, it was found that experienced senior students are more likely to be attracted to large established employers than to small-scale startups. Similar conclusions were obtained by a recent text-mining study of co-op job postings (Chopra & Golab, 2018), in which clusters of entry-level jobs were filled mostly by junior students. These previous studies serve as motivation for this work, which investigates how students and employers respond to competition, as reflected by how they rank their available options.

Prior work has also studied employer and student satisfaction with co-operative education (Jiang et al., 2015), including gender differences in students' satisfaction with the job and employers' satisfaction with co-op students (Chopra et al., 2019, 2020). This paper addresses a new problem related to satisfaction, namely whether students and employers are more satisfied if they are matched with their first choice compared to a backup choice.

More broadly, workforce studies have applied machine learning to improve talent recruitment and reduce turnover (Chien & Chen, 2008; Qin et al., 2018; Zhu et al., 2018). Recruitment tools such as network-based recommender systems can match applicants to jobs (Diaby et al., 2013; Qin et al., 2018; Zhu et al., 2018) and reduce the need to screen applicants manually (Shi et al., 2020). To improve hiring decisions, studies have focused on employer search strategies by measuring the number of applicants interviewed, time to hire, and personnel fit, and correlated these variables with performance, talent retention, and satisfaction (Barron et al., 1985; Chien & Chen, 2008; Cuevas, 2016). This study is orthogonal to these previous works; rather than improving hiring efficiency or matching jobs to applicants, it focuses on ranking strategies when making hiring decisions and how these decisions may be impacted by competition in the co-op job market.

Furthermore, workforce literature includes qualitative studies to understand how job seekers decide to apply or not apply for a job (Barber & Roehling, 1993). While location and compensation were the driving factors, the probability of being hired, as perceived by the applicants, also played a role. Another study interviewed applicants to understand whether an employer's recruitment process affected their decision to accept the job offer (Rynes et al., 1991). They found that recruitment delays, recruiter competence, gender composition of interview panels, and prior knowledge of the company affected job seekers' decisions, as did their gender, work experience, and job search success. This study can be thought of as following this line of work, by analyzing how the perception of competition may affect co-op job seekers' and employers' decision-making.

Overall, while past work studied employer and job seeker decisions at the application and interview stages, this paper addresses the subsequent shortlist, job offer and offer acceptance stages, focusing on the role of competition in co-op students' and employers' decision making and satisfaction.

DATA AND METHODS

Co-operative Process Overview

The co-op process studied in this paper proceeds as follows. Initially, participating employers submit job descriptions, and any student (enrolled in a co-op program) may apply for any job. Next, employers (represented by their ID E_x) interview selected students (represented by their ID S_x). They then rank these students in order of preference (by assigning them ranks between R0 and R9). A rank of zero, referred to as a 'No Rank' or R0, means that the employer is not willing to hire the student. A rank of one, referred to as an 'Offer' or R1, indicates that the employer wishes to hire the student. Ranks two to nine, referred to as 'Ranks' or R2 to R9, represent the employer's backup or shortlist options, in order of preference. In other words, the employer would consider hiring these students if the top-ranked student declines the offer. In the remainder of this paper, the terms 'shortlisted' and 'received a Rank' are used interchangeably. Ranks do not need to be distinct, for example, an employer may put five students on the backup list and give all of them a rank of two.

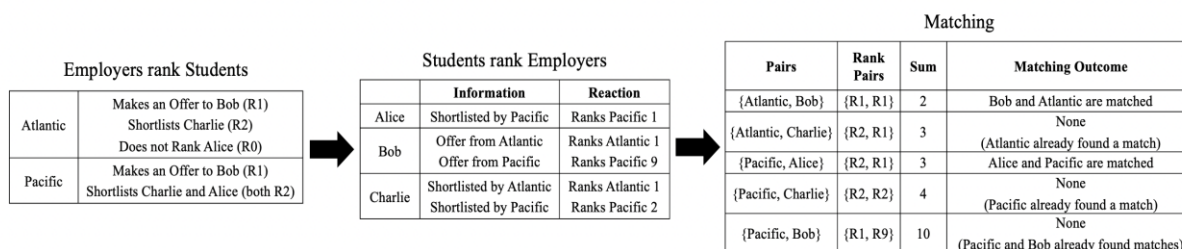
After employers have submitted their rankings, the following information becomes visible to students. For each interview they participated in, a student is shown whether the corresponding employer made them an Offer, shortlisted them (Rank - but the rank number is not shown), or is not willing to hire them (No Rank). Students then rank employers that made them offers or shortlisted them, between one and nine (shown as R1 to R9). As was the case with employer rankings, student ranks do not need to be distinct; for example, a student may give a rank of one to all of their options. In general, students assign a rank of one (or R1) to jobs they are interested in, a rank of nine (or R9) to jobs they strongly do not want, and ranks between two and eight (i.e., R2 to R8) to indicate an order of preference for the remaining options. An automatic student rank of zero is assigned to the No Ranks received.

The co-op matching system then applies a matching algorithm to assign students to jobs. The objective of the algorithm is to minimize the sum of the ranks of the resulting student-job assignment as a way to take the preferences of both parties into account. Students and employers are aware of this matching algorithm and thus rank each other accordingly. Note that the lowest possible sum of ranks is two, and occurs when an employer offers a job to a student and the student gives a rank of one to this job (i.e., both assign a rank of one or R1 to each other). In this case, the student is guaranteed to be matched with this job. In special cases where a student assigns a rank of one to multiple Offers, the algorithm would randomly select one of these Offers and match the student with it. Thus, the algorithm first considers rank pairs with a sum of two and matches these employers and students. Ties are broken randomly. Then, the algorithm considers the remaining unmatched jobs and students, scans for the lowest sums of ranks of three, four, and so on, and matches employers and students in that order. Consequently, students or employers may be matched with their first (R1), second (R2), or lower choice, or may not be matched at all. Finally, at the end of a work term, students and employers who were matched with each other evaluate each other.

Figure 1 illustrates the ranking and matching process (explained above) using an example consisting of two employers, Atlantic and Pacific, who interview three students, Alice, Bob, and Charlie. The first step shows that employers rank students; Atlantic makes an offer to Bob (i.e., assigns them a rank of one or R1), shortlists Charlie by giving him Rank 2 (or R2), and does not rank Alice (represented by R0). Pacific makes an offer to Bob (R1) and shortlists both Charlie and Alice by assigning each of them a rank of 2 (R2). Next, students rank the offers and ranks they receive. For example, Bob receives two offers (one from Atlantic and another from Pacific). He indicates his preference for Atlantic by ranking

it one (represented by R1) and ranking Pacific nine (R9). After employers and students rank each other, the matching algorithm matches students and employers in ascending order of their sum of ranks. For example, since Atlantic and Bob both ranked each other one (R1), the ranking pair with the lowest sum of two is {Atlantic, Bob}. The matching algorithm matches Atlantic and Bob, leaving the rank pairs with Pacific, Alice, and Charlie yet to be considered in the next round. At the end of the matching process, Bob, Alice, and Atlantic get their first choice (R1), Pacific gets their second choice (R2), and Charlie does not match with any job.

FIGURE 1: Example of the co-op ranking and matching process.



Data

This study analyzes one year of data, from September 2015 to August 2016, corresponding to 4,851 co-op job postings and 7,315 students enrolled in co-op engineering programs.

From the employer's perspective, the following data are analyzed:

- Job Postings, containing a job ID, job title, and employer name.
- Employer Rankings, containing a job ID and the distribution of ranks. Table 1 shows an example with five employers, one per row. The first row indicates that employer (whose job ID is) E1 gave two ranks of zero (#R0) and no other ranks, i.e., E1 interviewed two students and was not willing to hire either of them. The second row indicates that E2 interviewed two students, rejected one (R0), and put one on the shortlist with a rank of two (R2), and so on.
- Employer Evaluations, containing a job ID, the rank the employer gave to the student who was hired, and the employer's evaluation of the student (on a 7-point scale: unsatisfactory, marginal, satisfactory, good, very good, excellent, outstanding).

From the student's perspective, the following data are analyzed:

- Students, containing a (anonymized) student ID, gender, and the number of previous work terms completed at application time (from 0 to 5).
- Student Rankings, containing a student ID and the distribution of the ranks the student gave to the offers and shortlists (Ranks) received. Table 2 shows an example with five students, one per row. Table 2a shows how the students ranked the offers they received and Table 2b shows how the students ranked the employers that shortlisted them. The first row in both tables corresponds to student S1 and indicates that S1 did not receive any offers and was not shortlisted (and thus did not rank any employers). The second row in both tables corresponds to student S2. Table 2a shows that S2 did not receive any Offers. Table 2b shows that S2 was shortlisted by two employers and gave a rank of one to both. The third row shows that Student S3 received one offer and gave it a rank of nine, and so on.

- Student Evaluations, containing a student ID, the rank the student gave to the employer who hired them, and the student's evaluation of the employer (on a 10-point scale with ten being most satisfied).

The number of work terms completed corresponds to student seniority: junior students are those who have completed zero or one work term and senior students are those who have completed at least four work terms. The student population contains 23% females and 77% males, as well as 37% junior students and 27% senior students (and 36% intermediate students who have completed two or three work terms), which is representative of engineering programs at the university.

TABLE 1: Sample of employer ranking data, showing the distribution of ranks employers give to the students they interview.

	#R0	#R1	#R2	#R3	#R4	#R5	#R6	#R7	#R8	#R9
E1	2	0	0	0	0	0	0	0	0	0
E2	1	0	1	0	0	0	0	0	0	0
E3	4	2	0	0	0	0	0	0	0	0
E4	3	1	2	0	0	0	0	0	0	0
E5	1	1	1	1	1	1	0	0	0	0

TABLE 2: Sample of student ranking data.

(a) Distribution of ranks students give to the Offers they receive

	#R1	#R2	#R3	#R4	#R5	#R6	#R7	#R8	#R9
S1	0	0	0	0	0	0	0	0	0
S2	0	0	0	0	0	0	0	0	0
S3	0	0	0	0	0	0	0	0	1
S4	1	1	1	0	0	0	0	0	0
S5	1	0	0	0	0	0	0	0	2

(b) Distribution of ranks students give to the Ranks they receive

	#R1	#R2	#R3	#R4	#R5	#R6	#R7	#R8	#R9
S1	0	0	0	0	0	0	0	0	0
S2	2	0	0	0	0	0	0	0	0
S3	0	0	0	0	0	0	0	0	0
S4	0	0	0	0	0	0	0	0	0
S5	0	0	0	0	0	0	0	0	2

Methods

Given that the matching algorithm is designed to minimize the sum of the ranks of the student-job assignments, and given that students and employers are aware of this algorithm when making ranking decisions, students and employers may use different ranking strategies depending on the perceived level of competition. For example, employers may make one or more offers but not shortlist any students if they are confident that their offer(s) will be accepted (i.e., that those students will reciprocate with a student rank of one). On the other hand, less confident employers may shortlist multiple

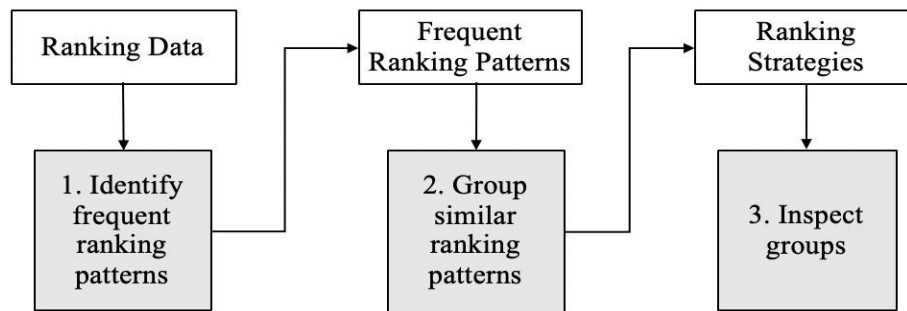
students, and, to maximize their chances of matching with any student, they may give a rank of two to all shortlisted students instead of ranking them in order of preference.

Similarly, students who receive offers may accept them or rank them lower if they strongly prefer an employer who shortlisted them (which is risky since this employer prefers another student). On the other hand, if a student strongly does not like any of their options and wishes instead to find a co-op job on their own (outside the institution's matching process), they may give all the jobs the lowest possible rank of nine. Students who do not receive any offers may be willing to take any job they were shortlisted for, and, therefore, may give the top rank of one to all of those employers. On the other hand, more confident students may indicate a preference for some employers over others by ranking their preferred options one, and ranking their other options nine (indicating that they do not prefer any other option) or two, three, and so on.

The goal of this paper is to identify these kinds of ranking strategies and use them to describe the level of competition faced by various groups of co-op students and employers. The methodology, consisting of three steps, is summarized in Figure 2 and explained below.

1. Identify frequent ranking patterns: commonly used sets of ranks are identified for students and employers. For example, an employer set of ranks of $\{0, 1\}$ corresponds to employers who give at least one No Rank (#R0), at least one Offer (#R1), and do not shortlist any students (ranks 2-9). Among the five employers shown in Table 1, Employer E3 is the only one with a set of ranks of $\{0, 1\}$ (E3 gave a rank of 0 to four students they interviewed, a rank of 1 (Offer) to two students, and did not give anyone a rank between 2-9). Furthermore, Employer E1's set of ranks is $\{0\}$, E2's is $\{0, 2\}$, E4's is $\{0, 1, 2\}$, and E5's is $\{0, 1, 2, 3, 4, 5\}$. Overall, in this step, the distributions of employer and student ranks (samples shown in Tables 1 and 2) are converted to the above set notation, and frequent sets of ranks (given by employers and students) are identified.
2. Group similar ranking patterns: informed by the previous step and by the nature of the matching process, similar sets of ranks are grouped together. These are referred to as ranking strategies. For example, employer rank sets of $\{0,1,2\}$, $\{0,1,2,3\}$ and so on may be grouped and labeled as employers who make a shortlist (in addition to making some offers and rejecting some students). This step partitions employers and students according to their ranking strategies.
3. Inspect groups: groups of employers and students with different ranking strategies are compared based on their a) characteristics and, b) consequences on matching and evaluation. Employer names and job titles were inspected to identify differences among employers who use different ranking strategies. For students, the percentage of females, junior, and senior students that use different ranking strategies was calculated. A two-tailed two-proportion z-test with a p-value of 0.05 was used to compare these fractions with the corresponding fractions of the student population. To understand the consequences of ranking strategies on matching and evaluation, the following metrics were calculated for each group of employers and students who used a given ranking strategy: a) the percentage who were not matched (represented as %NoMatch), b) the percentage who were matched with their first choice (represented as %MatchR1), and c) the percentage who were matched with their >1 choice (represented as %MatchR>1). Finally, average evaluation scores that matching students and employers gave each other at the end of the work term were reported.

FIGURE 2: Summary of methods.



The next two sections describe the results of the ranking strategy analysis as described in the Methods section: for employers, Employer Rankings and for students, Student Rankings. For each group, ranking strategies are identified as well as their effects on matching and work term satisfaction.

EMPLOYER RANKINGS

The first subsection analyzes the rankings given by 4,851 employers to identify frequent ranking patterns (Step 1 of Figure 2), group them into ranking strategies (Step 2 of Figure 2), and distinguish between employers with different ranking strategies (Step 3 of Figure 2). The next subsection analyzes the effects of ranking strategies on matching and satisfaction (Step 3 of Figure 2).

Employer Ranking Strategies

Figure 3 shows the distribution of ranks given by employers to students they interviewed. Recall that rank 0 or "No Rank" indicates that the student was interviewed but not considered for the job, rank 1 represents an offer, and ranks 2-9 represent employers' shortlists in order of preference. As seen in Figure 3, nearly half the ranks are zero, a quarter are offers, and ranks lower than three are rare.

Table 3 shows the most frequent sets of ranks given by employers. Many employers reject at least one student (rank 0), make at least one offer (rank 1), and shortlist at least one student, usually with ranks of 2 and/or 3. Nineteen percent of employers make offers without shortlisting anyone (second row, labeled {0,1}).

Using Figure 3 and Table 3, employers with similar ranking patterns (Step 2 of Figure 2) are grouped. Table 4 summarizes the groups. The first column, Label, describes each group. For example, the first group corresponds to employers that do not make any offers and do not shortlist (Rank) any students – that is, they only give zero ranks, meaning that they are not willing to hire any students they interviewed. The second and third columns indicate whether the employers in the given group gave any Offers and Ranks, respectively (ranks of two or three are referred to as Top Ranks). The next column shows the percentage of employers who used this ranking strategy (e.g., the first row indicates that 5% of employers did not give any Ranks or Offers). The next column reports the percentage of employers with a particular ranking strategy that were not matched with any students *by the algorithm*, labeled "%NoMatch"; clearly, employers who did not give any ranks or offers have a no-match rate of 100%. The next column, "%MatchR1", shows the percentage of employers that were matched with their first choice and the average evaluation score the employers gave to these students (higher is better). Finally, the last column, "%MatchR>1", shows the percentage of employers that were matched with a student who was not their first choice and the average evaluation score the employers gave to those

students. These percentages will be discussed further in the section *Consequences of Employer Ranking Strategies*.

Note that the sum of the percentages reported in the last three columns – "%NoMatch" plus "%MatchR1" plus "%MatchR>1" – is 100 for each row. In other words, there are three possible outcomes for employers: does not match with any student, matches with their first choice, or matches with their not-first choice.

FIGURE 3: Distribution of ranks given by employers.

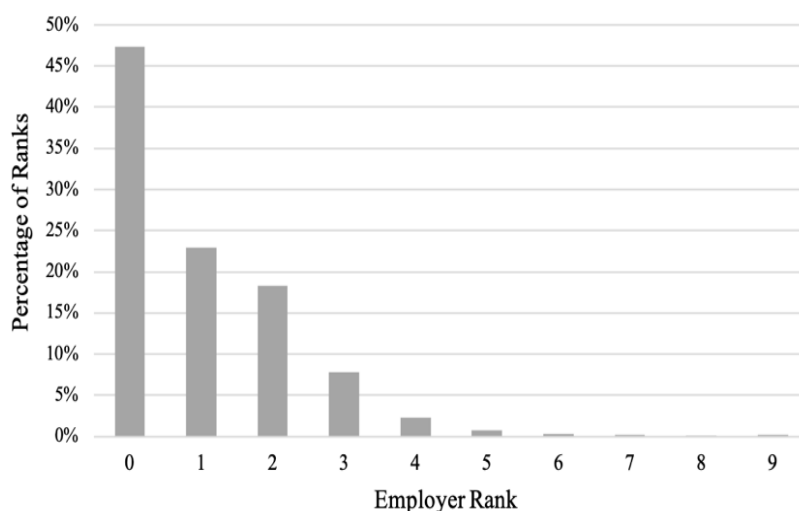


TABLE 3: Most frequent sets of ranks given by employers.

Set of Ranks	%
{0, 1, 2}	24
{0, 1}	19
{0, 1, 2, 3}	14
{1}	8
{0}	5
{1, 2, 3}	4
{1, 2}	4
{0, 1, 2, 3, 4}	4
{0, 2}	2
{1, 2, 3, 4}	2

TABLE 4: Ranking strategies of employers.

Label	Offer/s	Rank/s	%	%NoMatch	%MatchR1 (Avg(Eval))	%MatchR>1 (Avg(Eval))
No Offer/s or Rank/s	No	No	5	100	-	-
Only Rank/s	No	Yes	9	81	-	19 (5.9)
Only Offer/s	Yes	No	27	48	52 (6.1)	-
Offer/s & Top Rank/s	Yes	Yes (all $r \leq 3$)	48	31	46 (6.1)	24 (5.9)
Offer/s & Other Rank/s	Yes	Yes (some $r > 3$)	11	20	48 (6.2)	32 (5.9)

To characterize employers with different ranking strategies, their names and job titles are inspected (Step 3 of Figure 2). It was found that employers who gave:

- "No Offer/s or Rank/s" (first row of Table 4) consisted of companies of all sizes and industries, mainly offering "analyst" and "assistant" positions.
- "Only Rank/s" (second row) were mainly business units of the institution, and mostly offered "analyst", "support", and "intern" positions.
- "Only Offer/s" (third row) consisted of large well-known technology and manufacturing companies, offering "software developer" and "design" positions.
- "Offer/s and Top Rank/s" (fourth row) consisted of (a) medium-sized companies offering positions in "software development" and "data science", (b) large companies with positions such as "application development", "UI designer", "quality assurance", and "process improvement", and (c) companies with specialized jobs in electrical engineering, hardware, medical engineering, banking, etc.
- "Offer/s and Other Rank/s" (fifth row) consisted of small to medium-sized companies with job titles including "quality assurance", "software testing", "support technician", and "systems administrator".

Consequences of Employer Ranking Strategies

This section analyzes how ranking strategies used by employers affect their chances of finding a match and whether employers with different ranking strategies evaluate their matches differently at the end of the work term.

To provide context, the matching percentage and evaluation scores averaged across all the employers who participate in the ranking process (i.e., those who give at least one non-zero rank) are reported below (these numbers are not restricted to groups of employers with particular ranking strategies and hence, are not shown in Table 4). Overall, 39% of employers who participate in the ranking process do not find a matching student. Out of the 61% who find a match, 75% match with their first choice (i.e., with a student to whom they gave an Offer), and 25% match with their >1 choice. On average, employers who match with their first choice evaluate their students slightly higher (6.1) than those who match with their >1 choice (5.9). This difference is statistically significant at a p-value of 0.05.

Next, the consequences of employer ranking strategies on matching and evaluation are analyzed. Recall that Table 4 shows the percentage of employers with different ranking strategies who do not find a match, match with their first choice (i.e., with a student to whom they gave an Offer), and match with their >1 choice. For each ranking strategy, the average evaluation scores given by employers to their students are also shown.

The matching percentages in the fifth, sixth, and seventh columns of Table 4 indicate the following. Among employers who make offers, those who provide more backup options (Offers and Ranks) have a higher matching rate, with a greater proportion matching with their backup choice. Despite providing backup options, only 70% of these employers find a match (fourth and fifth row of Table 4). Additionally, one-fifth of the employers who 'Only Rank' (i.e., do not make any offers and only use ranks of two and above) find a match.

Next, the average evaluation scores in the fifth, sixth, and seventh columns of Table 4 indicate the following. On average, regardless of the ranking strategy used, employers who match with their first choice evaluate their students similarly and so do employers who match with their >1 choice. In addition, irrespective of the ranking strategy used, employers who match with their first choice evaluate their students slightly higher than those who matched with their >1 choice. Therefore, while employer ranking strategy affects the chances of finding a match, employers with different ranking strategies do not evaluate their students differently.

STUDENT RANKINGS

This section analyzes the rankings given by 7,315 students. Recall that for each interview, a student is shown whether the corresponding employer made them an Offer, shortlisted them (Rank - but students are not shown the rank number), or is not willing to hire them (No Rank). Students then need to give a rank between one and nine to the employers who made them an Offer or shortlisted them.

Student Ranking Strategies

Figure 4 shows the distribution of ranks that students give to the Offers and Ranks they receive. The most frequent student ranks include 1 and 9, with very few students ranking their options between 2 and 8. Additionally, Figure 4 shows that a higher proportion of students rank the Offers they receive one and the Ranks they receive nine.

Ranking an Offer one means that the student is guaranteed to match with this job offer. However, ranking a Rank one may or may not lead to a match (it may lead to a match if the student who was offered this position does not rank the offer one). Therefore, in line with Figure 4, students may react differently to Offers and Ranks.

Additionally, students with different numbers of Offers and Ranks may react differently; in other words, they may use different ranking strategies. For example, students who did not receive any Offers but were shortlisted may rank all their options one in order to increase their chances of finding any job. On the other hand, students who receive multiple Offers may rank the offers in order of preference. Therefore, to analyze student ranking strategies, students are first divided based on the number of Offers and Ranks they receive. Then, frequent ranking patterns are identified for each group.

FIGURE 4: Distribution of ranks given by students.

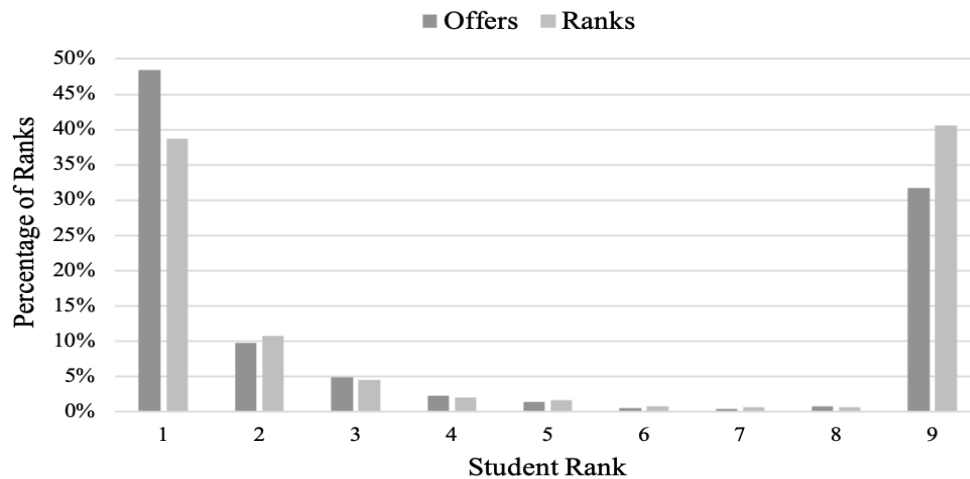


Table 5 lists the combinations of (a) Offers (none, one, or more), and (b) Ranks (yes or no) received by students to define students in different situations. The table also lists the proportion of all students, female students, junior students and senior students in each situation. As seen in Table 5, senior students are more likely to receive multiple Offers and junior students are more likely to not receive any Offers. Since students who receive no Offers or Ranks do not rank any employers, they are excluded from further analysis.

The subsections that follow analyze the ranking patterns of students in different situations, depending on the number of Offers and Ranks they receive. For each situation, frequent ranking patterns are identified (Step 1 of Figure 2), grouped into ranking strategies (Step 2 of Figure 2), and students with different ranking strategies are compared (Step 3 of Figure 2). The section *Consequences of Student Ranking Strategies* further analyzes the effects of student ranking strategies on matching and satisfaction (Step 3 of Figure 2).

TABLE 5: Groups of students according to offers and ranks they receive.

Label	Offer/s	Rank/s	%	%F	%Jr	%Sr
No Offer or Rank	No	No	19	20	42	26
Only Rank/s	No	Yes	29	24	45	19
Single Offer	Yes (1)	No	13	20	30	36
Single Offer & Rank/s	Yes (1)	Yes	16	22	37	26
Multiple Offers	Yes (>1)	No	5	21	20	47
Multiple Offers & Rank/s	Yes (>1)	Yes	17	25	31	32

Ranking Strategies in Various Situations

Frequent sets of ranks given to Offers and Ranks were identified to capture ranking patterns of students in various situations (Step 1 of Figure 2). Table 6 reports the ranks given by students with multiple Offers and Rank/s. Most students in this situation accept one of their Offers (by ranking it one) and rank their other options nine (first row, capturing 45% of students). Other students accept an Offer and give ranks of two, three or nine to their other options. In rare cases, students give a rank of nine to all their options (second-last row). In this case, these students would most likely not be matched with any job.

Following Step 2 of Figure 2, ranking patterns that lead to a similar outcome are grouped, in turn identifying ranking strategies used by students who receive multiple Offers and Rank/s (shown in Table 7e). Similarly, ranking strategies of students in other situations, such as of those who receive only Ranks or a single Offer, are shown in Tables 7a through 7d.

TABLE 6: Most frequent sets of ranks given by students who receive multiple Offers and Ranks.

To Offers	To Ranks	%
{1, 9}	{9}	45
{1, 2}	{2}	5
{1, 2}	{3}	3
{1, 2}	{9}	3
{1, 2, 9}	{9}	2
{1, 9}	{1, 9}	2
{1, 9}	{1}	1
{1, 9}	{2}	1
{9}	{9}	1
{1, 2, 3}	{4}	1

Before discussing ranking strategies, the contents of Table 7 are explained below. There are five separate tables, labeled (a) through (e), corresponding to different student situations in terms of the number of Offers and Ranks received. In each table, rows represent ranking strategies used by students in that situation. The first column, Label, describes each ranking strategy. For example, Table 7e shows the ranking strategies of students who received multiple Offers and Ranks. The first row in this table corresponds to students who rank one of the Offers one (i.e., they are guaranteed to match with this job). The second row corresponds to students who, in addition to ranking an Offer one, also rank another option one. The third and fourth rows indicate the other ranking strategies that students use after accepting an Offer. Recall that once a student ranks an Offer one, they will be matched with it. Therefore, ranking strategies in rows two, three, and four indicate students' ranking preference without affecting their chances of finding a match. The fifth row corresponds to students who rank all their Offers greater than one (in turn, reducing their chance of finding a match). The sixth and seventh rows indicate how students rank other options after ranking all their Offers greater than one; the sixth row corresponds to students who take risks by ranking a Rank one instead of ranking an Offer one, and the seventh row corresponds to students who rank all their options greater than one (indicating that they do not consider any of the options to be ideal).

The second column shows the percentage of students with a particular ranking strategy, as a proportion of the number of students in the same situation (in terms of the number of Offers and Ranks received). For example, Table 7e shows that among students who receive multiple Offers and Ranks, students either rank an Offer one (93%) or rank all of their Offers greater than one (7%). Among students who rank all Offers greater than one, 74% of students rank another option one (i.e., these students rank all Offers greater than one and rank a Rank one, in turn, taking a risk). The remaining 26% rank all their options, including the Offers received, greater than one (indicating that they do not consider any of the options ideal and want to reduce their chance of matching with any of them).

The third, fourth, and fifth columns, labeled $\% \Delta F$, $\% \Delta Jr$ and $\% \Delta Sr$, indicate the difference between the percentage of females, junior, and senior students in a given group (consisting of students with a particular ranking strategy) and all the students in that situation (those percentages are shown in Table 5). Additionally, if the difference is statistically significant at a p-value of 0.05, it is marked with an

asterisk. For example, Table 7e shows that, in comparison to the percentage of junior students who receive multiple Offers and Ranks (31% according to the last row of Table 5), students who *rank an option one after they accept an Offer* have 16% more (i.e., 47%) junior students (second row, fourth column of Table 7e). The asterisk indicates that the proportion of junior students in the two groups (31% vs. 47%) is statistically significantly different with a p-value less than 0.05.

The next column, labeled %NoMatch, reports the percentage of students who were not matched with any employer (clearly, students who ranked an Offer one were always matched with the employers making those offers). The next column shows the percentage of students who were matched with their first choice and the average evaluation score the students gave to these employers. Finally, the last column shows the percentage of students who were matched with an employer that was not their first choice and the average evaluation score the students gave to these employers.

Ranking strategies of students who received only Ranks and no Offers (listed in Table 7a) indicate the following. The first row of Table 7a shows that almost 70% of students who only receive Ranks maximize their chances of finding a match by giving a rank of one to all the employers who shortlisted them. The next largest group of students (last row) give a rank greater than one to all the employers who shortlisted them, indicating that perhaps they consider none of the available options to be ideal.

Table 7a also shows that, in comparison to the proportion of junior students who receive only Ranks (45%, as shown in the second row of Table 5), a higher proportion of junior students rank all their options one (first row of Table 7a), and a lower proportion of junior students state a preference for one option over another (second and third row) or rank all their options greater than one (fourth row). In addition, a higher proportion of female students do not provide backup choices (third row).

Similarly, Tables 7b through 7e show how students in other situations react to the Offers they receive, followed by their reactions to their other options.

Summary of Ranking Strategies

As shown in Tables 7a through 7e, students in different situations use different ranking strategies. The strategies appear to serve one of the following purposes: maximizing the chance of finding a match, reducing the chance of finding a match, indicating a preference even at the risk of reducing the chance of finding a match, or only communicating a preference. Below is a summary of student ranking strategies in various situations, and whether their use varies by gender or seniority (shown in the first five columns of Tables 7a to 7e).

First, student ranking strategies that maximize the chance of finding a match are inspected (first row of Tables 7a to 7e):

- Most students rank in a way that maximizes their chance of finding a match: almost 70% of students who only receive Ranks rank all their options one (first row of Table 7a) and more than 80% of students who receive one or more Offers accept one (first row of Tables 7b to 7e).
- Among students who receive both Offers and Ranks, fewer students maximize their chance of finding a match in comparison to those who receive only Offers. For example, 82% of students who receive single Offer and Ranks react by ranking an Offer one (first row of Table 7c), in comparison to 95% of students who only receive an Offer (first row of Table 7b).
- A higher proportion of junior students (who receive only Ranks) use strategies that maximize their chances of finding a match (ranking all options one).

Second, students' ranking strategies that reduce their chance of finding a match are examined (last row of Tables 7a to 7e). Students who use this strategy may not consider any of the available options ideal and, therefore, want to reduce their chances of matching with any of them:

- 14% of students who receive only Ranks (i.e., are shortlisted) rank all their options greater than one (last row of Table 7a).
- Under 5% of students who receive Offers rank all their options greater than one (last row of Tables 7b to 7e), reducing their chance of finding a match (as much as possible). Students who receive only Offers do so by ranking all the Offers they receive greater than one (last row of 7b and 7d), and students who receive both Offers and Ranks do so by ranking all the Offers and Ranks greater than one.
- A higher proportion of senior students act this way.

Third, students who employ risky ranking strategies are examined.

- Among students who only receive Ranks, some students rank their options distinctly instead of ranking all their options one (second and third row of Table 7a). Fewer junior students rank in this manner.
- Among students who receive both Offers and Ranks, some students take risks by ranking their Offers greater than one, and instead ranking a Rank one (second-last row of Tables 7c and 7e). Fewer senior students use this strategy.
- Overall, a higher percentage of students who receive only Ranks take these kinds of risks (second and third row of Table 7a), followed by those who receive a single Offer and Ranks (second-last row of Table 7c), and multiple Offers and Ranks (second-last row of Table 7e).

Lastly, this section discusses ranking strategies that only reveal students' preferences rather than their desire to maximize or minimize the chances of obtaining a particular job. This is done by analyzing how students rank their remaining options once they have accepted an Offer (the indented rows under the first row of Tables 7c, 7d, and 7e). Recall that if a student ranks an Offer one, they will get that job, regardless of how they rank their Ranks. It is found that, after ranking an Offer one,

- A higher proportion of senior students rank their other options nine.
- A higher proportion of female and junior students provide backup choices.
- A higher proportion of junior students rank some of their other options one.

Consequences of Student Ranking Strategies

This section analyzes how ranking strategies used by students affect their chance of finding a match, especially with their first choice. It also inspects whether students with different ranking strategies and rank of match evaluate their employers differently at the end of the work term. Recall that Tables 7a through 7e show the percentage of students in different situations with different ranking strategies who do not find a match, match with their first choice, and match with their >1 choice. The table also shows the average student evaluations.

Before examining the consequences of particular ranking strategies, the matching rate and average work term evaluation across all students who participate in the ranking process are reported below. Overall, 22% of students who participate in the ranking process (i.e., those who receive at least one Offer or Rank) do not find a match. Out of the 78% who find a match, 95% match with their first choice, and only 5% match with their >1 choice. On average, students who match with their first choice

evaluate their employers higher (8.4) than those who match with their >1 choice (7.8). This difference is statistically significant at a p-value of 0.05. These numbers provide context and are not restricted to groups of students in particular situations or those with particular ranking strategies, and hence, are not shown in Table 7.

TABLE 7: Ranking strategies of students who receive different number of Offers and Ranks.
(a) Only Rank/s

Label	%	% ΔF	% ΔJ_r	% ΔS_r	%NoMatch	%MatchR1 (Avg(Eval))	%MatchR>1 (Avg(Eval))
Rank All 1	69	0	6*	-2	53	47 (8.3)	-
1 & Rank Any Other <9	8	-1	-5	-1	32	55 (8.4)	14 (7.9)
1 & Rank All Others 9	10	6*	-20*	4	28	57 (8.0)	14 (8.0)
Rank All >1	14	-4	-11*	10*	81	-	19 (7.9)

(b) single Offer

Label	%	% ΔF	% ΔJ_r	% ΔS_r	%NoMatch	%MatchR1 (Avg(Eval))	%MatchR>1 (Avg(Eval))
Rank Offer 1	95	-1	0	1	-	100 (8.5)	-
Rank Offer >1	5	9	4	-12	46	-	54 (7.2)

(c) single Offer and Rank/s

Label	%	% ΔF	% ΔJ_r	% ΔS_r	%NoMatch	%MatchR1 (Avg(Eval))	%MatchR>1 (Avg(Eval))
Rank Offer 1	82	1	1	1	-	100 (8.3)	-
Rank Any Other 1	24	3	17*	-13*	-	100 (8.0)	-
Rank Any Other <9	36	3	6	-3	-	100 (8.2)	-
Rank All Others 9	40	-2	-14*	12*	-	100 (8.5)	-
Rank Offer >1	18	-4	-3	-3	27	46 (8.4)	26 (7.8)
Rank Any Other 1	79	-3	0	-8*	18	59 (8.4)	23 (7.5)
Rank All Others >1	21	-5	-13	13	62	-	38 (8.4)

(d) multiple Offers

Label	%	% ΔF	% ΔJ_r	% ΔS_r	%NoMatch	%MatchR1 (Avg(Eval))	%MatchR>1 (Avg(Eval))
Rank an Offer 1	98	-1	0	0	-	100 (8.5)	-
Rank Any Other <9	39	0	7	-9	-	100 (8.4)	-
Rank All Others 9	61	-1	-4	5	-	100 (8.6)	-
Rank All Offers >1	2	46*	-20	19	50	-	50 (8.0)

(e) multiple Offers and Rank/s

Label	%	% ΔF	% ΔJ_r	% ΔS_r	%NoMatch	%MatchR1 (Avg(Eval))	%MatchR>1 (Avg(Eval))
Rank An Offer 1	93	0	0	1	-	100 (8.5)	-
Rank Any Other 1	9	-2	16*	-9	-	100 (8.0)	-
Rank Any Other <9	43	5*	8*	-4	-	100 (8.5)	-
Rank All Others 9	48	-4	-10*	6*	-	100 (8.5)	-
Rank All Offers >1	7	-2	1	-7	22	42 (7.6)	36 (7.5)
Rank Any Other 1	74	-1	3	-11	4	57 (7.6)	39 (7.7)
Rank All Others >1	26	-3	-5	3	74	-	26 (6.8)

Now, the effect of student ranking strategies on matching and evaluation (as shown in the last three columns of Tables 7a through 7e) is studied. Table 7a suggests that students who only received Ranks and ranked all their options one had the lowest matching rate (first row). On the other hand, students who stated a preference for one option over another were more likely to be matched, and more likely to be matched with their first choice (second and third row of Table 7a). This observation suggests that students who ranked all their options one may have been aware of the high level of competition they were facing, and therefore used a ranking strategy that maximizes their chance of finding a match. Nevertheless, fewer of these students found a match, in comparison to those who indicated an ordered preference.

As expected, all students who ranked an Offer one matched with that employer (first row of Tables 7b to 7e). Among students who took a risk by giving a rank of one to an employer who shortlisted them instead of an employer who made them an offer (second-last row of Tables 7c and 7e), most matched with their first choice, some matched with their >1 choice, and a few did not find co-op employment. Lastly, most students who wanted to reduce their chances of finding a match, and therefore, ranked all their options greater than one (last row of Tables 7a to 7e), did not match with any employer. Others matched with their >1 choice, especially if their >1 choice was an Offer.

Regardless of student situations and ranking strategies, students who matched with their first choice evaluated their employers more highly than or equal to those who matched with their >1 choice (average evaluation scores in the second-last column of Tables 7a through 7e are greater than or equal to the corresponding average evaluation scores in the last column). Additionally, Table 7 shows that students gave slightly different evaluations when using different ranking strategies. However, no clear trend is visible.

DISCUSSION

The results of this study suggest that ranking strategies may be used to characterize the extent of competition in the co-op job market. Employers and students appear to be aware of the competition they face. Their perception of competition affects their confidence to find suitable matches, which informs the ranking strategy they use.

Employer Ranking Strategies

Some employers are less likely to provide backup options. It appears that these employers are confident in their ability to hire their top choices, and if their top choices decline the offers, these employers are willing to risk not hiring any students from this university. Large employers with sought-after job opportunities rank in this manner. On the other hand, small to medium companies, especially those offering entry-level positions, are more likely to provide backup options while ranking. The use of this ranking strategy suggests that these employers perceive competition for their top choices and are not confident that their top choices will take the job. A fifth of these employers do not find any students at the end of the matching process. Therefore, an employer's popularity and quality of job they offer is correlated with the ranking strategy they use.

Workforce literature reports that large organizations, especially those built on the high performance organization (HPO) framework, attract better talent because they offer a more open culture and invest in their employees' training and development (Bilau et al., 2015; Hiltrop, 1999). This may explain why some companies are more confident in their ability to attract co-op students, and thus state clearer preferences in their ranking. Similar observations were made in many competitive environments,

including supply chains and legal contracting, where parties with more bargaining power leverage their reputation when negotiating with others (Kennedy, 1981; Webster, 1995). In the context of co-op job markets, past work characterized competition by grouping employers who interview the same set of students (Toulis & Golab, 2017). The paper showed that small companies face competition from employers of all sizes and industries, and large companies mostly compete amongst themselves (Toulis & Golab, 2017). This may explain why small companies specify backup options when making co-op hiring decisions.

Student Ranking Strategies

Student ranking strategies also reflect confidence and perception of competition. Based on their situation (in terms of the options they received), confidence, and perception of competition, students respond differently to the options they have. Past research confirms a relationship between self-confidence and risk-taking. One study found that subjects who felt more confident saw more opportunities in a risky choice and therefore took more risks (Krueger & Dickson, 1994). These feelings of self-confidence were found to be based on past success, feedback, or irrational beliefs about luck (Darke & Freedman, 1997; Krueger & Dickson, 1994). Another study that conceptualized decision-making in gambling (where probabilities and payoffs are known) found that a person's "importance beliefs" and "information-processing capabilities" drove their decision-making (Slovic & Lichtenstein, 1968). For example, a person with little money and a fear of losing it may focus on the amount to lose, disregarding other information provided (Slovic & Lichtenstein, 1968). Similarly, in this study, students' confidence and perception of competition may have influenced their risk-taking capacity during ranking.

Students who perceive more competition are less confident in their ability to find a match. Therefore, these students are more likely to employ a ranking strategy that maximizes their chance of finding any job and are less likely to take risks. For example, most students who were shortlisted but did not receive any offers reacted by maximizing the chances of obtaining any job rather than stating a clear preference for one job over another. Even then, their chances of finding a match are low. A higher proportion of junior students rank in this manner. Since employers prefer candidates with relevant work experience (Chopra & Golab, 2018; Coll et al., 2002), this ranking strategy seems reasonable. In addition, since many students enroll in co-op programs to try out different career paths (Anderson et al., 2012), junior students with little work experience may try to match with any job they can get.

Students who perceive less competition are more confident about finding a suitable match (within or outside the institution's matching process). Therefore, they are more likely to state a clear preference for some options over others, even at the risk of finding a match. For example, some students chose employers who shortlisted them over those who made them an offer. While most of these students matched with their first choice, a few matched with their lower choice or did not find co-op employment through the institution's matching process. This indicates that most students accurately perceived the competition they were facing and ranked accordingly. In fact, some students rank in a way that appears to minimize their chance of finding a match. These students likely did not find any options to be ideal and prefer to find a co-op job on their own (outside the institution's matching process). A higher proportion of senior students rank in this manner. These findings suggest that senior students generally perceive less competition than junior students. Senior students are more confident in their ability to find a co-op job (within or outside the institution's matching process) and therefore employ more risky ranking strategies. This aligns with previous studies that show that a) senior students receive more co-op opportunities, and therefore, face less competition than junior

students (Chopra & Golab, 2018; Jiang & Golab, 2016; Toulis & Golab, 2017), and b) risk-taking increases with age (Mata et al., 2011), experience (Hertwig & Erev, 2009; Madan et al., 2017), and with the perception of power (Maner et al., 2007).

Students' confidence in their ability to find a job affects how they state their preferences; students who are less confident are more likely to state their backup choices even if they give a rank of one to an offer. A higher proportion of junior students rank in this manner. A possible explanation for this ranking strategy (ranking backup options after accepting an offer) could be to minimize the risk associated with a possible, yet rare, job cancellation. This is in line with past work suggesting that people who have less experience with a given task take fewer risks when performing it (Madan et al., 2017).

Analysis of the consequences of ranking on evaluation revealed that the rank of match affects satisfaction. Irrespective of the ranking strategy, employers and students who match with their first choice evaluate their counterparts slightly higher than those who match with their backup choices. In other words, satisfaction only seems to depend on the rank of the match and not on the strategy used to obtain the match. To the best of the authors' knowledge, there is no prior work on an individual's satisfaction with their backup choice in any context. However, one qualitative study found that even in the face of adversity, aspiring entrepreneurs found it difficult to drop their Plan A and adopt Plan B (Mullins & Komisar, 2009). Entrepreneurs kept thinking about their original plan instead of acknowledging the need to adapt. Lower evaluations of backup choices by employers and students in this study may have happened due to similar thinking.

This study also revealed gender differences in ranking behavior. A higher proportion of female students who received no offers (i.e., who were only shortlisted) stated a clear preference for some of their options, in turn reducing their chance of matching (which is maximized if a rank of one is given to all the options). This finding contradicts past work, which suggests that women, especially in male-dominated engineering fields, are less confident in their abilities and therefore are more likely to accept less desirable opportunities without stating any preferences (Marra et al., 2009; Samek, 2019; Tsui, 1998). On the other hand, the study found that more female students who accepted an offer stated their backup choices anyway. These students, similar to junior students who commonly use this ranking strategy, seem to be either risk-averse or not confident about finding a co-op job. Similar to these findings, past work on risk-taking presented conflicting reports on how risk-averse women are (Nelson, 2015).

Analysis of student ranking strategies suggests that students take risks according to the situation they are in. Students in situations that provide the least certainty of finding a match (i.e., those who are shortlisted for jobs, but receive no Offers) are most likely to take risks. This observation is in line with past work suggesting that a nothing to lose attitude promotes risky behavior (Harris et al., 2002). Additionally, more students who receive Ranks in addition to Offers are willing to take risks compared to students who only receive Offers. A possible explanation of risky behavior in such situations may be a feeling of power and increased self-confidence associated with the increased number of available options (Krueger & Dickson, 1994; Maner et al., 2007; Slovic & Lichtenstein, 1968).

Implications for Practitioners and Researchers

The results of this study reveal insights into competition and satisfaction and can be useful for employers, students, and educational institutions. The results can inform employers and students about the extent of competition in the co-op market, which can help them decide how to rank their options given the competition they are likely to face. For example, employers who struggle to find co-

op students may adjust their perception of competition and inform their talent recruitment and ranking strategies. These employers may target different students or increase the number of backup options they provide. Similarly, new employers may use these findings to understand the competition that they are likely to face and make informed ranking choices.

Understanding employer ranking strategies may help students inform their application and ranking strategies and target employers who are more likely to hire them. In addition, the method presented in this paper can help the institution identify students with different ranking strategies and offer the support they need. For example, students who appear to face a great deal of competition through their ranking patterns may be identified and given support, such as resume reviews or mock interviews. Since junior students appear to face more competition, mentoring programs may be arranged in which senior students help junior students navigate the co-op process. The proposed method can also identify students who take risks or act in a way that reduces their chances of finding a match. These students may benefit from receiving advice on finding suitable co-op opportunities. Specifically, the institution may consider hosting consultation sessions during the student ranking phase to help students make informed choices.

The institution may use these findings to prepare students and employers for a competitive co-op job market, and to manage the expectations of junior students. Further, some employers are confident in their ability to hire their top choices, indicating that such jobs are highly sought after by students. The institution may consider recruiting more such employers. On the other hand, the institution may recommend smaller employers to less-experienced students to increase these students' chances of finding co-op employment. In addition, this study found that some students rank their options in a way that minimizes their chances of finding a match, perhaps because these students did not like any of their options and preferred to find a co-op job on their own. The institution may want to track these 'self-arranged jobs' and recruit similar employers.

Since students who match with their backup choice appear to be less satisfied with their employers, the institution may allow students to not rank a job, similar to the No-Rank option available to employers. Since early career experiences can greatly affect subsequent career choices, ensuring student satisfaction with co-operative work placements can reduce career attrition in the future. The institution may also contact employers and students who are matched with their backup choice to discuss each other's expectations before the work term begins. This can create a better learning environment during work terms, and increase satisfaction and retention.

Finally, these results fill a gap in the co-operative education literature. Prior work investigated competition (Chopra & Golab, 2018; Jiang & Golab, 2016; Toulis & Golab, 2017) and its impact on students' well-being (Drewery et al., 2019; Parsa & Golab, 2020), but this is the first paper to explore how students and employers respond to competition. The findings presented in this paper call for practitioners and researchers to a) identify the effects of competition on students and employers, b) suggest methods to prepare them for the competition they are likely to face, and c) mitigate the effects of competition to increase employer and student satisfaction and retention in co-operative programs.

CONCLUSIONS

This paper proposed a new way of characterizing competition in a co-operative job market by studying how students and employers rank each other after a round of interviews. Based on a dataset from a large co-operative education program, this study identified ranking strategies, examined the

characteristics of employers and students who use different strategies, and analyzed the effects of ranking strategies on matching and work term evaluations.

The study revealed data-driven insights into competition and satisfaction in a co-op job market. It was found that ranking strategies used by employers and students correspond to their perception of competition. Small employers, especially those offering entry-level positions, and junior students chose ranking strategies that maximize their chances of finding a match. On the other hand, large employers and senior students were more likely to only state their most preferred choices. In terms of satisfaction, it was found that students and employers gave higher work term evaluations when matched with their top choice than when they were matched with their backup choice.

These results should be interpreted carefully since they are based on data from a single institution. However, the methodology presented in this paper may be used by others to reflect the extent of competition in their institutions through ranking patterns. Additionally, this study is limited to identifying frequent patterns in the data, but not cause-and-effect relationships. Thus, it provides a starting point for further study: interviewing students and employers about the competition they face in the co-op market is an interesting direction for future work.

REFERENCES

- Anderson, E., Johnston, N., Iles, L., Mcrae, N., Reed, N., & Walchli, J. (2012). Co-operative education and student recruitment, engagement and success: Early findings from a multi-institutional study in British Columbia. *Journal of Cooperative Education & Internships*, 46(1), 58-76.
- Barber, A. E., & Roehling, M. V. (1993). Job postings and the decision to interview: A verbal protocol analysis. *Journal of Applied Psychology*, 78(5), 845-856. <https://doi.org/10.1037/0021-9010.78.5.845>
- Barron, J. M., Bishop, J., & Dunkelberg, W. C. (1985). Employer search: The interviewing and hiring of new employees. *The Review of Economics and Statistics*, 67(1), 43-52. <https://doi.org/10.2307/1928433>
- Bilau, A. A., Ajagbe, M. A., Kigbu, H., & Sholanke, A. B. (2015). Review of shortage of skilled craftsmen in small and medium construction firms in Nigeria. *Journal of Environment and Earth Science*, 5(15), 98-109.
- CEWIL Canada [Co-Operative Education And Work-Integrated Learning Canada]. (2021). *Co-operative education membership*. <https://cewilcanada.ca/CEWIL/Membership/>
- Chien, C.-F., & Chen, L.-F. (2008). Data mining to improve personnel selection and enhance human capital: A case study in high-technology industry. *Expert Systems with Applications*, 34 (1), 280-290. <https://doi.org/10.1016/j.eswa.2006.09.003>
- Chopra, S., & Golab, L. (2018). Job description mining to understand work-integrated learning. In K. E. Boyer & M. Yudelson (Eds.), *Proceedings of the 11th International Conference on Educational Data Mining* (pp. 32-43). EDM.
- Chopra, S., Golab, L., Pretti, T. J., & Toulis, A. (2018). Using data mining methods for research in co-operative education. *International Journal of Work-Integrated Learning*, 19(3), 297-310.
- Chopra, S., Khan, A., Mirsafian, M., & Golab, L. (2019). Gender differences in work-integrated learning assessments. In M. C. Desmarais, C. F. Lynch, A. Merceron, & R. Nkambou (Eds.), *Proceedings of the 12th International Conference on Educational Data Mining* (pp. 524-527). EDM.
- Chopra, S., Khan, A., Mirsafian, M., & Golab, L. (2020). Gender differences in work-integrated learning experiences of stem students: From applications to evaluations. *International Journal of Work-Integrated Learning*, 21(3), 253-274.
- Coll, R. K., Zegwaard, K., & Hodges, D. (2002). Science and technology stakeholders' ranking of graduate competencies part 1: Employers perspective. *Asia-Pacific Journal of Cooperative Education*, 3(2), 19-28.
- Cuevas, A. (2016). *Global recruiting trends 2016*. LinkedIn Talent Solutions. https://business.linkedin.com/content/dam/business/talent-solutions/global/en_us/c/pdfs/GRT2016_Global-SMB-Edition_111615.pdf
- Darke, P. R., & Freedman, J. L. (1997). Lucky events and beliefs in luck: Paradoxical effects on confidence and risk-taking. *Personality and Social Psychology Bulletin*, 23(4), 378-388. <https://doi.org/10.1177/0146167297234004>
- Diaby, M., Viennet, E., & Launay, T. (2013). Toward the next generation of recruitment tools: An online social network-based job recommender system. *Proceedings of the IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM)*, 821-828. <https://doi.org/10.1145/2492517.2500266>
- Drewery, D. W., Cormier, L. A., Pretti, T. J., & Church, D. (2019). Improving unmatched co-op students' emotional wellbeing: Test of two brief interventions. *International Journal of Work-Integrated Learning*, 20(1), 43-53.

- Haddara, M., & Skanes, H. (2007). A reflection on cooperative education: From experience to experiential learning. *Asia-Pacific Journal of Cooperative Education*, 8(1), 67-76.
- Harris, K. M., Duncan, G. J., & Boisjoly, J. (2002). Evaluating the role of "nothing to lose" attitudes on risky behavior in adolescence. *Social Forces*, 80(3), 1005-1039. <https://doi.org/10.1353/sof.2002.0008>
- Hertwig, R., & Erev, I. (2009). The description-experience gap in risky choice. *Trends in Cognitive Sciences*, 13(12), 517-523. <https://doi.org/10.1016/j.tics.2009.09.004>
- Hiltrop, J. M. (1999). The quest for the best: Human resource practices to attract and retain talent. *European Management Journal*, 17(4), 422-430. [https://doi.org/10.1016/S0263-2373\(99\)00022-5](https://doi.org/10.1016/S0263-2373(99)00022-5)
- Jiang, Y., & Golab, L. (2016). On competition for undergraduate co-op placements: A graph mining approach. In T. Barnes, M. Chi, & M. Feng (Eds.), *Proceedings of the 9th International Conference on Educational Data Mining* (pp. 394-399). EDM.
- Jiang, Y. H., Lee, S. W. Y., & Golab, L. (2015). Analyzing student and employer satisfaction with cooperative education through multiple data sources. *Asia-Pacific Journal of Cooperative Education*, 16(4), 225-240.
- Kennedy, D. (1981). Distributive and paternalist motives in contract and tort law, with special reference to compulsory terms and unequal bargaining power. *Maryland Law Review*, 41(4), 563-658.
- Krueger, N., Jr., & Dickson, P. R. (1994). How believing in ourselves increases risk taking: Perceived self-efficacy and opportunity recognition. *Decision Sciences*, 25(3), 385-400.
- Madan, C. R., Ludvig, E. A., & Spetch, M. L. (2017). The role of memory in distinguishing risky decisions from experience and description. *The Quarterly Journal of Experimental Psychology*, 70(10), 2048-2059. <https://doi.org/10.1080/17470218.2016.1220608>
- Maner, J. K., Gailliot, M. T., Butz, D. A., & Peruche, B. M. (2007). Power, risk, and the status quo: Does power promote riskier or more conservative decision making? *Personality and Social Psychology Bulletin*, 33(4), 451-462. <https://doi.org/10.1177/0146167206297405>
- Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2009). Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *Journal of engineering education*, 98(1), 27-38. <https://doi.org/10.1002/j.2168-9830.2009.tb01003.x>
- Mata, R., Josef, A. K., Samanez-Larkin, G. R., & Hertwig, R. (2011). Age differences in risky choice: A meta-analysis. *Annals of the New York Academy of Sciences*, 1235(1), 18-29. <https://doi.org/10.1111/j.1749-6632.2011.06200.x>
- Mullins, J., & Komisar, R. (2009). *Getting to plan B: Breaking through to a better business model*. Harvard Business Press.
- Nelson, J. A. (2015). Are women really more risk-averse than men? A re-analysis of the literature using expanded methods. *Journal of Economic Surveys*, 29(3), 566-585. <https://doi.org/10.1111/joes.12069>
- Parsa, M. S., & Golab, L. (2020). Social media mining to understand the impact of co-operative education on mental health. In A. N. Rafferty, J. Whitehall, C. Romero, & V. Cavalli-Sforza (Eds.), *Proceedings of the 13th International Conference on Educational Data Mining* (pp.653-657). EDM.
- Qin, C., Zhu, H., Xu, T., Zhu, C., Jiang, L., Chen, E., & Xiong, H. (2018). Enhancing person-job fit for talent recruitment: An ability-aware neural network approach. *Proceedings of the 41st International ACM SIGIR Conference on Research and Development in Information Retrieval*, 25-34. <https://doi.org/10.1145/3209978.3210025>
- Rynes, S. L., Bretz, R. D., Jr., & Gerhart, B. (1991). The importance of recruitment in job choice: A different way of looking. *Personnel Psychology*, 44(3), 487-521. <https://doi.org/10.1111/j.1744-6570.1991.tb02402.x>
- Samek, A. (2019). Gender differences in job entry decisions: A university-wide field experiment. *Management Science*, 65(7), 2947-3448. <https://doi.org/10.1287/mnsc.2018.3107>
- Shi, B., Li, S., Yang, J., Kazdagli, M. E., & He, Q. (2020). Learning to ask screening questions for job postings. *Proceedings of the 43rd International ACM SIGIR Conference on Research and Development in Information Retrieval*, 549-558. <https://doi.org/10.1145/3397271.3401118>
- Slovic, P., & Lichtenstein, S. (1968). Relative importance of probabilities and payoffs in risk taking. *Journal of Experimental Psychology*, 78(3, Pt 2), 1-18. <https://doi.org/10.1037/h0026468>
- Thiel, G. R., & Hartley, N. T. (1997). Cooperative education: A natural synergy between business and academia. *SAM Advanced Management Journal*, 62(3), 19-25.
- Toulis, A., & Golab, L. (2017). Graph mining to characterize competition for employment. *Proceedings of the 2nd International Workshop on Network Data Analytics*, Article 3. <https://doi.org/10.1145/3068943.3068946>
- Tsui, L. (1998). The effects of gender, education, and personal skills self-confidence on income in business management. *Sex Roles*, 38(5), 363-373. <https://doi.org/10.1023/A:1018701704103>
- Webster, J. (1995). Networks of collaboration or conflict? Electronic data interchange and power in the supply chain. *The Journal of Strategic Information Systems*, 4(1), 31-42. [https://doi.org/10.1016/0963-8687\(95\)80013-G](https://doi.org/10.1016/0963-8687(95)80013-G)
- Zhu, C., Zhu, H., Xiong, H., Ma, C., Xie, F., Ding, P., & Li, P. (2018). Person-job fit: Adapting the right talent for the right job with joint representation learning. *ACM Transactions on Management Information Systems (TMIS)*, 9(3), 1-17. <https://doi.org/10.1145/3234465>



About the Journal

The International Journal of Work-Integrated Learning (IJWIL) publishes double-blind peer-reviewed original research and topical issues dealing with Work-Integrated Learning (WIL). IJWIL first published in 2000 under the name of Asia-Pacific Journal of Cooperative Education (APJCE). Since then the readership and authorship has become more international and terminology usage in the literature has favored the broader term of WIL, in 2018 the journal name was changed to the International Journal of Work-Integrated Learning.

In this Journal, WIL is defined as "*an educational approach that uses relevant work-based experiences to allow students to integrate theory with the meaningful practice of work as an intentional component of the curriculum. Defining elements of this educational approach requires that students engage in authentic and meaningful work-related task, and must involve three stakeholders; the student, the university, and the workplace*". Examples of practice include off-campus, workplace immersion activities such as work placements, internships, practicum, service learning, and cooperative education (Co-op), and on-campus activities such as work-related projects/competitions, entrepreneurship, student-led enterprise, etc. WIL is related to, but not the same as, the fields of experiential learning, work-based learning, and vocational education and training.

The Journal's main aim is to enable specialists working in WIL to disseminate research findings and share knowledge to the benefit of institutions, students, co-op/WIL practitioners, and researchers. The Journal desires to encourage quality research and explorative critical discussion that leads to the advancement of effective practices, development of further understanding of WIL, and promote further research.

The Journal is ongoing financially supported by the Work-Integrated Learning New Zealand (WILNZ; www.wilnz.nz), and the University of Waikato, New Zealand, and received periodic sponsorship from the Australian Collaborative Education Network (ACEN) and the World Association of Cooperative Education (WACE).

Types of Manuscripts Sought by the Journal

Types of manuscripts sought by IJWIL is primarily of two forms: 1) *research publications* describing research into aspects of work-integrated learning and, 2) *topical discussion* articles that review relevant literature and provide critical explorative discussion around a topical issue. The journal will, on occasions, consider good practice submissions.

Research publications should contain; an introduction that describes relevant literature and sets the context of the inquiry. A detailed description and justification for the methodology employed. A description of the research findings - tabulated as appropriate, a discussion of the importance of the findings including their significance to current established literature, implications for practitioners and researchers, whilst remaining mindful of the limitations of the data, and a conclusion preferably including suggestions for further research.

Topical discussion articles should contain a clear statement of the topic or issue under discussion, reference to relevant literature, critical and scholarly discussion on the importance of the issues, critical insights to how to advance the issue further, and implications for other researchers and practitioners.

Good practice and program description papers. On occasions, the Journal also seeks manuscripts describing a practice of WIL as an example of good practice, however, only if it presents a particularly unique or innovative practice or was situated in an unusual context. There must be a clear contribution of new knowledge to the established literature. Manuscripts describing what is essentially 'typical', 'common' or 'known' practices will be encouraged to rewrite the focus of the manuscript to a significant educational issue or will be encouraged to publish their work via another avenue that seeks such content.

By negotiation with the Editor-in-Chief, the Journal also accepts a small number of *Book Reviews* of relevant and recently published books.



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