Experiences of Computer Science Transfer Students

Harrison Kwik
The Allen School, DUB Group
University of Washington
Seattle, Washington, USA
kwikh@cs.washington.edu

Benjamin Xie
The Information School, DUB Group
University of Washington
Seattle, Washington, USA
bxie@uw.edu

Amy J. Ko
The Information School, DUB Group
University of Washington
Seattle, Washington
ajko@uw.edu

ABSTRACT

About half of recent computer and information science graduates attended community college at some point. Prior work on transfer students in general suggests that the transfer process can engage people from underrepresented communities, but can also be academically and socially "shocking". However, we know little about the experiences of transfer students in computer science in particular. We used the Laanan-Transfer Student Questionnaire (L-TSQ) to survey 25 transfer students and 135 native (non-transfer) students and conducted follow-up interviews with 8 transfer students attending a large public 4-year university in a city with significant technology industry presence. We found that while transfer students were more diverse demographically, the support of the university for transfer student orientation tended to mitigate social shocks of transferring. This did not, however, eliminate gaps in academic performance. These findings suggest that there are other non-social factors that influence academic performance that CS programs must support to equitably engage students who transfer.

CCS CONCEPTS

• **Social and professional topics → Computing education**; *User characteristics*;

KEYWORDS

transfer students, community college, undergraduate experience, computing education, transfer shock

ACM Reference Format:

Harrison Kwik, Benjamin Xie, and Amy J. Ko. 2018. Experiences of Computer Science Transfer Students. In *ICER '18: 2018 International Computing Education Research Conference, August 13–15, 2018, Espoo, Finland.* ACM, New York, NY, USA, 9 pages. https://doi.org/10.1145/3230977.3231004

1 INTRODUCTION: TRANSFER INTO CS

Many students do not follow a direct path to a 4-year computer science degree. The National Science Foundation's 2010 National Survey of Recent College Graduates (in the United States) revealed that 52.8% of bachelor's degree recipients in computer and information science attended some form of community college before graduating. Moreover, students who transferred from community colleges tended to be more diverse racially, ethnically, and socioeconomically than students who only attend 4-year colleges and universities [17]. For example, Hispanic students are over-represented in the public two-year colleges. When students manage to overcome the complex and tangled web of pathways from community colleagues to 4-year colleges [11], they can increase the diversity of CS student populations.

What happens *after* students transfer? Prior work on transfer students in general suggests many possible outcomes. Hills identified that students experienced *transfer shock*, "a severe drop in [academic] performance upon transferring" [9]. A meta-review of 62 subsequent studies on this phenomenon found that many students experienced up to a half grade point drop in GPA, and only some recovered after a year [6].

Later work showed that when experiences are dis-aggregated by academic discipline, significant differences emerged. Cejda found that students in humanities actually experienced *increases* in grade point averages, while students transferring into business, mathematics, and sciences experienced a significant *decrease* in grade point average. [4]. Further research on these discipline-specific findings found that these findings particularly occurred for underrepresented minorities transferring into engineering programs [28], but were not found for students above the age of 24 [20].

While research on engineering transfer students shows persistent evidence of transfer shock, there is some reason to believe that computer science transfer students may experience even more severe challenges. For example, CS has not only severe underrepresentation of women and minority groups [29], but also challenges with offering inclusive learning environments [18]. These factors may further exacerbate transfer shock.

Only a few studies have specifically investigated CS transfer students. One investigated the social experiences of CS transfer students at the University of Central Florida [19]. The study measured relationships between students' self-reported social engagement in school and their graduating GPA, finding that transfer students appear to engage in social and academic experiences less than native students and that students who engaged less tended to have lower GPAs after transferring. A second considered the pathways that community college students take to pursue CS, finding that pathways are diverse, complex, and challenging, and that completion of bachelor's degrees in CS was rare [11]. A companion report found that community college students struggled to prepare for transfer when considering CS transfer pathways, and have limited knowledge of how to apply CS concepts and prepare for careers [16]. Another study reported on a cohort-based transfer program, which allowed students to complete a bachelor's degree in CS in

ICER '18, August 13–15, 2018, Espoo, Finland

ACM ISBN 978-1-4503-5628-2/18/08…$15.00
https://doi.org/10.1145/3230977.3231004

three years [22]. The study found strong transfer and graduation rates, as well as successful employment post-graduation.

These studies, however, have not focused on the specific experiences that transfer students have once they have transferred, leaving gaps in our understanding of factors that may prevent successful graduation. We asked two questions that address these gaps: **1) What are the social and academic experiences of CS transfer students? 2) How do the social and academic experiences of CS transfer students differ from native students?**

To answer these questions, we surveyed transfer and native students, and interviewed transfer students.

2 THEORETICAL FRAMEWORK

We framed this study from the perspectives of Student Involvement Theory, and Social and Cultural Capital, following a similar framing as prior work on transfer students [12, 13, 21].

The first theory is Student Involvement Theory [1], a developmental theory about higher education that attempts to explain how environmental influences impact student development [1]. It defines involvement as *the quantity and quality of physical and psychological energy that the student devotes to the academic experience.* In this model, students have personal characteristics when they enter an institution that interact with the affordances of the institutional environment. An institution's programs, policies, faculty, peers, and educational experiences to which the student is exposed can influence student development, but only to the extent to which students devote physical and psychological energy in learning. In this theory, student involvement is on a continuum of both quantity and quality. This theory states that greater student involvement in college translates to greater development and learning, while also recognizing that students have a finite amount of time and *quality* of involvement is important. The conceptual work of Astin [1] and others suggests that four types of influences need to be considered to understand the relationship between students and their institutional environments: 1) pre-college characteristics relating to student student demographics, 2) organizational or structural characteristics of the institution(s), 3) students' academic experiences, 4) students' nonacademic experiences (e.g. social) [25].

The second part of our theoretical framework related to social and cultural capital. Social capital is "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" [3, 27]. It states that investment in social relations can provide an advantage or expected returns [15]. People can benefit from social capital by using it to facilitate information flow, influence others through social ties, validate credentials, and reinforce identity. Transfer students may use social capital to connect with study groups, leverage tutoring resources, and feel included in a CS department's community, all of which may feed back into deeper engagement and learning. Related to social capital is *cultural capital.* For this study, cultural capital refers to how different cultural contexts can impact unequal scholastic achievement [3, 27]. Cultural capital can help explain how internalized values, attitudes, norms, and beliefs that stem from individual and societal cultures can influence stratification that occurs within an educational institution. Prior work has shown that a lack of related cultural identity or connection can hinder STEM students of color [7, 24] and that adversarial relationships within school culture can limit future work opportunities for graduates [30].

3 METHOD: SURVEY & INTERVIEW

We surveyed and interviewed native and transfer students at the University of Washington, Seattle. We will refer to this university as *UW* throughout the rest of this paper.

3.1 Setting: Large public 4-yr research univ.

UW is a large public 4-year research university in the United States. The campus is located in an urban environment near a large technology hub. During the 2017-2018 school year, 18% (1511 out of 8285) of incoming students were transfer students. Among the incoming transfer student population, 86.7% (1310 out of 1511) of students transferred from a community college in the state. Admittance to UW is moderately competitive, with 40.6% (2307 out of 5683) of the transfer student applicants being admitted. During the 2017-2018 school year, 44.1% of undergraduate students identified as Caucasian, 24.1% as Asian American, 7.4% as Hispanic/Latino, 3.9% as African-American, 1.3% as American Indian/Alaska Native, and 0.9% as Native Hawaiian/Pacific Islander [23].

Admittance into UW does not guarantee admittance to a major unless an applicant applies for and is accepted directly into a department. If a student does not begin their enrollment with a declared major, their major status is denoted as "pre-major." Students may apply for intended major(s) during application periods. Majors at UW are either *open*, *minimum*, *capacity-constrained*, or *mixed*. Open majors can be declared at any time by students in good standing. Minimum majors can be declared at any time by students who have completed a set of prerequisite courses with a minimum GPA. Capacity-constrained majors require that students complete a set of prerequisite courses to be eligible to apply. Applicants to capacity-constrained majors compete for a limited number of spaces. Mixed majors have requirements based on in-major concentration.

For the 2017-18 class, the ten most popular majors were capacity-constrained. This major system is a frequent restriction on students' ability to study desired disciplines and is a commonly cited reason for student frustration. CS, the most popular first-choice major since 2016, admits about one-third of applicants. The majority of CS students are admitted through this process, but most transfer students are admitted through transfer direct admission, and are generally high performing students at their previous institution.

Transfer students who are admitted into the major are encouraged to attend university-wide and department-level orientations. Since the 2016-2017 school year, the CS department offers a short quarter-long *transfer seminar* for incoming transfer students. The seminar provides information about campus and department resources, focused on assisting with transfer student adjustment. Transfer students also commonly meet with academic advisors who assist with course planning and general college preparation.

Regarding the positioning of authors to transfer students, the first author was an undergraduate transfer student majoring in CS at the time of the study. They also helped develop the curriculum of the transfer seminar before beginning the study. Their data was not used in the study. The second author was a native Ph.D. student in a

different department than CS, and the third author was an Associate Professor with adjunct appointment to the CS department.

3.2 Survey: adapted from L-TSQ

The goal of our survey was to reach a representative sample of the CS student population at UW. Following our theoretical framework, we adapted our survey instrument from the Laanan's Transfer Student Questionnaire (L-TSQ) (Appendix A of [21], [14]), a survey framed within Student Involvement Theory [1]. The L-TSQ measures transfer students' academic and social adjustment as a function of four stages of perceptions and experiences: 1) background, 2) previous institutions, 3) transfer process, and 4) current university [2, 12, 14]. Within these stages are 18 factors that measure academic and social involvement, perceptions, and details relating to different stages of the transfer process. Because of limited sample size, we relied on the factor analysis of Laanan et al. 2010 to map questions to factors, and factors to stages (Figure 1, Appendix B of [14]).

The *background* stage asked about mother and fathers' education and parental income, and motivations for transferring spanning two factors: *Motivations for transfer* and *Reasons for transfer*. The *previous institution* stage considered experiences with coursework and learning at the transfer student's previous institution. It contained two factors: *Experiences with general courses at previous institution* and *Course learning at previous institution*. The *transfer process* stage had four factors: *Experiences with academic counselors at previous institutions*, *Experiences with faculty at previous institutions*, *Perceptions of the transfer process*, and *Learning and study skills at previous institutions*. The *current university* stage considered six factors relating to perceptions, learning, and experiences at the current university: *General perceptions of the university*, *General perceptions of faculty*, *Satisfaction with the university environment*, *Experiences with faculty at UW*, *Course learning at UW*, and *Stigma as transfer student*. Because this stage relates to both native and transfer students, all respondents responded to these questions.

We also included questions from the L-TSQ about academic adjustment (difficulty of adjustment, experiencing an initial dip in GPA) and social adjustment (difficulty of adjustment, making friends). At the end of the survey, we included three free response prompts that we developed which asked students to discuss factors that contributed to their adjustment, advice that they would give to others, and information that the survey may have not asked about. We asked these questions to capture additional details about student involvement and social and cultural capital.

Because the CS major generally (but not always) admitted students after their 2nd year, and we were interested in students' experiences in the major, our inclusion criteria for participation required that students had been in the major for at least one quarter term and had taken at least one upper-division CS course.

We worked with the CS department's academic advisors to obtain the email addresses of students eligible for the study. This resulted in a list of 930 students. We then sent a recruitment email inviting participants over the age of 18 to complete the survey within the next five weeks. We distributed the survey twice, at the beginning of the fall and winter quarters of the 2017-18 school year. During each distribution period, we sent two additional emails to remind students of the survey. We solicited across two quarters to include incoming students for the new school year who were not initially contacted in the fall.

Out of the 930 students we contacted, we received 160 survey responses, for a response rate of 17.2%. Of those contacted, 88 were transfer students, with 25 responding, for a response rate of 28.4%.

3.3 Interviews with transfer students

To help interpret the survey data, transfer students who responded to the survey were invited to participate in semi-structured interviews. We conducted interviews with 8 of the 25 students contacted.

We grouped our final interview questions by categories we adapted from the *current university* stage of the L-TSQ survey. We asked about course engagement, engaging with faculty, perceptions of the department culture, and the adjustment process. We conducted interviews remotely and in-person. Prior to the interview, we informed participants of the study objectives and the content of the questions. We also informed participants that they could skip any questions and that the interview would be recorded. Interviews lasted about 30 minutes each, and were audio recorded and later transcribed. We used the factors from the survey to classify responses to the interview; this was straightforward, as we had structured the interview around the factors in the survey. We then compared transfer and native students' responses to *current university*, academic and social adjustment, and free-response questions.

4 RESULTS: STAGES OF TRANSFER EXP.

We organized our results by the four stages of the L-TSQ which considered student involvement and human capital at sequential stages of the transfer process. At each stage, we combined our quantitative and qualitative data.

4.1 Background: older, lower SES

The first stage of the survey was background, which included personal factors about students' lives. Table 1 shows a summary of these factors, comparing native and transfer students.

Only 28% of transfer students came from households with income over $80,000, compared to 68% of native students. Transfer students' parents tended to have less college education, with 44% of transfer students being first generation college students. Native students were twice as likely to have 2 parents with Bachelor's degrees (74%). Nearly all respondents identified as white or Asian, with only 4% of transfer students and 3% of native students identifying as a member of an underrepresented minority group, consistent with the ethnic demographics of the CS department (as reported by academic counselors).

Transfer student were older, with 64% being older than 21, compared to only 9% of native student. Only about half of transfer students lived within walking distance of campus, compared to at least 78% of native students. This age disparity may also explain why 36% of transfer students identified as financially independent, compared to only 5% of native students.

Transfer students' motivations and reasons for attending their new university largely related to job prospects for transferring: 72% agreed that getting a good job was a motivation for transferring to this university whereas only 40% were motivated to transfer because of admission to graduate or professional schools.

Table 1: Demographics of native and transfer students

variable	student type label	transfer (n=25)	native (n=135)
gender identity	male	84%	60%
	female	16%	38%
age group	18-19 years old	16%	30%
	20-21 years old	20%	59%
	22-23 years old	20%	9%
	24-28 years old	20%	0%
	29 years or older	24%	0%
parent's education	first-generation (0 parents w/ BA)	44%	13%
	one parent w/ BA	20%	13%
	two parents w/ BA	36%	73%
parents' household income	less than $20,000	4%	5%
	20,000–39,999	8%	4%
	40,000–59,999	12%	10%
	60,000–79,999	8%	6%
	$80,000 or more	28%	63%
	student is independent	36%	5%
matriculation	transfer from 2 yr	92%	
	transfer from 4 yr	8%	
place of residence	university housing	0%	33%
	non-university housing within walking distance	40%	39%
	non-university housing not walking distance	48%	10%
	with parents or relatives	8%	14%
	fraternity or sorority	4%	4%
ethnicity (some identified as multiethnic)	White (non-hispanic)	60%	41%
	Asian/ Pacific Islander	48%	61%
	African American	4%	0%
	Hispanic or Latinx	0%	2%
	Native American or Alaskan Native	0%	1%
standing at time of survey	1st yr undergrad	0%	1%
	2nd yr undergrad	4%	16%
	3rd yr undergrad	44%	39%
	4th yr undergrad	48%	41%
	5th yr undergrad	0%	1%
	graduated (BA)	4%	1%
	5th yr joint BA/Masters	0%	1%
overall GPA	median	3.61	3.74
	range	2.5-3.9	3.0-4.0

4.2 Previous institutions: felt well-prepared

When describing their activities at previous institutions, transfer students reported high engagement. Of the transfer students, 86% reported often or very often trying to see how different facts and ideas fit together, 84% often or very often considered practical applications of their knowledge. They tended to engage with their peers, with 84% of them often or very often trying to explain materials to friends and 72% often or very often participating in class discussion. About 40% of transfer students reported that the coursework at their previous institution often or very often involved working on a paper or project that integrated ideas from various sources, but 40% reported *never* doing so.

Most transfer students felt their previous institutions' coursework prepared them for being a CS major (76% agree) and for the academic standards at UW (68% agree). They felt that previous coursework developed their critical thinking skills (92% agree) and was intellectually challenging (76% agree), but they were in less agreement about whether coursework required extensive reading and writing (52% agree). When engaging with the course material, transfer students tried to draw connections and interact with peers. These sentiments were reflected in responses: "The quality of the teachers at my previous college for CS were amazing and helpful in getting me where I am today." Those who felt less prepared thought their previous courses were not challenging: "I feel like the courses at my previous college were a bit too easy, making me feel like I'm a little behind from everyone else in my [current] classes."

4.3 Transfer process: resourceful and confident

Transfer students reported overall confidence in their learning and study skills, reflecting the social capital they accrued at their previous institutions. When asked how academic experiences at their previous institutions provided the skills needed for their new university, transfer students were most confident in problem solving skills (76% agree) and writing skills (72% agree) and least confident in reading (56% agree) and research skills (56% agree).

Transfer students were divided about the effectiveness of the academic counselors at their previous institution, with only 48% finding them helpful. Only 32% of students reported meeting with academic counselors regularly, but they often did discuss transferring (76% agree). In contrast, 64% of students also spoke with counselors at their new university, and 80% of students researched various aspects of their new university to get a better understanding of the environment and academic expectations. This data suggests that transfer students consulted with multiple sources to understand the transfer process, although they may have had concerns with the helpfulness of the information they received.

Relationships with faculty at previous institutions were informal and comfortable, with 80% of transfer students often or very often approaching faculty outside of class and 68% often or very often meeting with them informally before or after class. Students tended not to discuss career aspirations (32% did so often or very often), instead speaking about course related topics.

4.4 University experience: a sense of inclusion

Our richest data, and the core focus of this paper, concerned the 4th stage in our framework, *university experience*. We analyzed transfer student interviews to supplement survey data. We discuss the factors that notably impacted student experiences regarding course learning, experiences with faculty members, general perceptions of UW and its CS culture, adjustment process, and college satisfaction. We included quotes from survey and interview responses.

4.4.1 Perceptions of UW Culture. Overwhelmingly, transfer students had positive general perceptions of UW, as they would recommend the university to another transfer student (92% agree) and would have selected the same university had they done their transfer process all over again (84% agree).

Culturally, every interview participant but one believed that students were highly collaborative and social within the department. Five participants described other students in the department as friendly and welcoming, as one participant explained:

> I've never gotten a cold shoulder from somebody or felt like I was bothering them. I think you might have a different reaction if you were in one of the general libraries... but in CS, especially because we have our own labs, it's easier to just turn to somebody next to you and ask them what they're working on.

Participants mentioned a strong culture of working together. One participant suggested that working in a group setting was a universal expectation among students due to difficult coursework.

Academically, interview participants were somewhat split on the competitive culture of the department and how much students cared about their grades. Three participants explicitly described students as "competitive" but had varying impressions of how that impacted them, ranging from "unhealthy" to "motivating". Three participants believed that most students cared a lot about their grades, while two described their peers as not caring. One common explanation for competition within the department was the presence of grading curves, which five participants mentioned, such as in this quote:

> The curves for one just set it up to be competitive. I mean, you feel the curve. It's kind of in a sense everyone against each other when you're graded on a curve.

Interview participants also talked about the competitive major system and its impact on academic culture as well. Multiple participants believed that because most students in the department had to work very hard in their courses to be able to enter the major, focus on grades carried over post-admittance.

4.4.2 College Satisfaction. While 76% of transfer students felt a sense of belonging at the university, only 56% felt that there was a sense of community on campus. They also tended *not* to feel stigmatized by others for being a transfer student, with only 8% perceiving that faculty underestimated them and 16% perceiving that other students underestimated them. Some (20%) agreed that there was a general stigma among students for starting at a community college.

Transfer students tended to be older, live further away from campus than native students, and many were financially independent from their parents, so they may not have spent as much time on campus with other students. This sentiment was echoed by all 4 interview participants who were older than typical native students (≥25 years old). They mentioned their age as a factor that impacted how they interacted with campus life. They found that they were less involved with social events and activities on-campus due to friends outside of the university, distance from younger students, and familial obligations. Despite less social engagement, they still felt as though the department had a friendly and welcoming culture.

Although most interview participant shared positive overall impressions of UW, one participant identified the competitive nature of UW (explained in 4.4.1) as detrimental:

> The competitive nature of UW that is one of the reasons that, as a student who actually wants to learn computer science in a positive way, I would *not* say UW is the best school. (emphasis added)

This interview participant went on to say that the prestige of UW was a source of this negative competitiveness, as students use the reputation as something to "brag about". Two other interview participants mentioned the reputation of UW, with one finding that it helped enable access to research opportunities:

> UW is this big research school and it's nice to know that you already have an "in" as a student there. You can meet faculty and grad students... It's easier when you have a lot of people around doing a lot of cool things to network and find what you want to do.

Two participants specifically liked that UW was a major research institution. One participant explained:

> I think being at a university where there is a lot of really interesting research going on is pretty cool. I haven't had an opportunity to take advantage of that, but it's definitely something that I intend to do before I graduate. It's cool to know that there are people doing innovative, and cutting-edge work around you.

UW also afforded access to other opportunities, as four participants specifically mentioned the importance of career resources. One participant explained that despite not using the career resources available to them, simply having the opportunity was reassuring and motivating. Another described the significance of finding a job after graduating and the how UW supports that:

> It's great being able to go to a couple of career fairs every year and get experience talking to recruiters. Being able to talk with people you're trying to get a job from, that helps you. The interviewing workshops, stuff like that. The resume workshops. All that extra stuff that is non-course oriented. That stuff is all huge and I think [the CS department] does a great job of that.

Four participants were pleased with the resources available around campus, including study spaces, the department labs, and the university's recreation center.

4.4.3 Course Learning. Transfer students' involvement with courses at the university largely paralleled that at their previous institutions, with the exception of a decrease in participation in class discussion. Similar to what they did at their previous institutions, a majority of transfer students reported often or very often thinking about practical implications of what they were learning (96%), trying to explain materials to friends (88%) and trying to see how different ideas fit together (80%). There was a decrease in the frequency of participation in class discussion, with only 44% reporting that they often or very often participated at the university compared to the 72% that stated that they often or very often participated at their previous institution. Larger class sizes that do not afford discussion may explain this decrease in class participation.

Every interview participant but one described a strong motivation to attend course lectures. The remaining participant explained that they occasionally skipped lectures in favor of watching lecture recordings online. Many students cited difficulty of concepts and inability to learn content using textbooks alone as reasons why lectures were so important to them.

Fewer students attended office hours often. Reasons for infrequent attendance varied, including descriptions of office hours as "for specific questions" or a "last resort," while other students discussed inconvenience and inability due to scheduling.

Most students worked with their peers as a regular part of their study habits, although three of the eight participants mentioned a preference for independent study. One participant that studied alone explained that he initially worked with others when he first

entered the major, but stopped once he became accustom to computer science coursework. Those who primarily worked in groups found it to be more helpful, as described by one participant:

> I've found that it's a lot more productive than trying to work it out by yourself. Typically if one person can figure out one part of the problem and another person can figure out another part, it gets done a lot faster and you're more likely to be correct about the answer.

4.4.4 Experiences with Faculty Members. Another difference between transfer students' experiences at their previous institution and UW was with faculty. Transfer students generally felt that faculty at UW were interested in students' development (84% agree), approachable (60% agree) and accessible (64% agree). Despite this, many transfer students reported not often engaging with faculty. Only 44% of transfer students reported often or very often approaching faculty at their current university outside of class, a sharp decrease from the 80% who reported doing so at their previous institution. Only 20% reported often or very often meeting informally before or after class with UW faculty, a decrease from the 68% who reported doing so at their previous institution. This general decrease in reported engagement with faculty may be because students consulted more so with other resources, such as other teaching staff or because of larger class sizes.

This decrease in reported engagement with faculty may not have been problematic, as every interview participant was satisfied with the overall teaching quality of faculty members and their experiences with them. Despite noting larger class sizes and professors seeming busy, participants all described faculty members as accommodating and accessible. One participant explained:

> Access to faculty has been really good here at UW. It was something I was wondering about when I was transferring in because usually classes at community colleges are 30 or 35 people maximum. But then you go to a class here where there might be over 100 people in one lecture hall and there are multiple sections taught by the same professor. So you would think that it would be harder to get in touch with professors, but I haven't found that to be the case at all. Every single one of my professors has had weekly office hours that are usually times that you can get to them.

Faculty members were perceived as high-achieving and intelligent by two participants. This impression of faculty members caused one participant to feel somewhat intimidated, although not enough so to deter interactions. Another participant felt as though the intelligence of faculty members detracted from their teaching:

> Some things [faculty] might think a student understands intuitively, because they understand it intuitively. I feel like they don't always explain... I might not understand intuitively what they're saying.

No participants found that faculty members were so inaccessible or intimidating that they avoided interactions with them, suggesting that transfer students are satisfied with their experiences with faculty despite reporting fewer interactions with them.

4.4.5 Adjustment Process. We identified common factors that interviewees cited when discussing social and academic adjustment.

The most commonly mentioned factor to impact social adjustment among interview participants was friendship, with all 8 participants mentioning friendship as a strong positive influence on their transfer process. Three participants discussed having friends who attended UW before transferring, which eased their transition. One participant found the social adjustment easy:

> I've been living near campus and working on campus for a few years before coming here. I live with a bunch of students. I already have a pretty large friend group outside of school with people who are in other majors. Besides the academics, there wasn't much more of an adjustment to be made. I've been living in this house for a few years and I'm 5 minutes away from campus so I already have my life and it hasn't really changed much besides different academics.

Interview participants noted making new friends after transferring. They found this process relatively easy, although one participant noted challenges with finding a study group:

> Sometimes there are people that are just in their own study group and they don't want other people in their study group. I actually ran across that. I asked someone if I could join their study group and they weren't positive towards that.

While most participants sought out and found friendships, they each had various motivations for making friends and explanations for why friendship was helpful. One participant mentioned that friendship helped ease loneliness and stress; another participant recalled friendship being helpful while he was still at his community college. Most participants described finding friendships within the department, but participants also mentioned meeting others through extracurricular activities, such as clubs and athletics, and communities like campus fraternities and sororities.

Academically, increased difficulty of coursework was a common factor among participants. Some participants felt as though they did not know how large the gap in difficulty between their previous college and UW would be, and all but one participants described a significant increase in challenge upon transferring. Often, this shift in coursework and grading was a primary drawback on adjustment; one participant explained that he ultimately quit his job:

> When I got here the classes were a lot harder and the grading was much more intense. It was almost by a factor of two or something. The difference was big. Big enough that I decided that I needed to stop working, just to focus on school... I think adjusting for me was mostly about stepping up to this intense grading system.

Three participants noted the impact of commuting on their academic adjustment. Commuting made it harder for participants to work with others and access resources such as office hours. Participants cited commute times of up to 1.5 hours. One participant, after describing commuting as taking time away from his family, stated:

> I think one of the things as a transfer student is that being a commuter makes things a little more difficult. The amount of time you have to spend commuting is an added challenge on top of school. I would say that commuting is probably the number one thing there.

Another student noted how commuting impacted collaboration:

> I feel like there is a big culture of people working together to understand material. In some ways, I feel like that's a good thing, and in other ways I feel like that's not really fair to a lot of students. If you work by yourself, you won't understand as much as if you work with other students. If you commute, you can't work with other students.

Two participants mentioned having to adapt to large class sizes. Although neither participant believed that large classes were significantly problematic or could be helped, one participant described how this impacted their relationship with faculty members:

> I don't really interact with professors that much outside of class, when I did that a lot in community college. But we had smaller classes and the professor gets to know you inside of class so it's easier to talk to them outside of class. That's not something that necessarily happens at UW for me. So maybe the reason why I'm not going to seek out professors outside of class is because I already feel like I'm a stranger to them when meanwhile at community college I was always having a lot of interactions with professors.

One interview participant, who transferred to UW but did not directly transfer into CS, found that stress caused by the competitive major system impacted his adjustment process. He explained the stress of not immediately gaining admission into the CS major:

> Had I been a direct admit, or direct transfer, I would have avoided all this stress from going to UW for a while and not getting in, and having to take engineering "weeder" classes. But it seemed like something too risky for me, because I know how few direct transfers actually get into the department. To me, it seems like the less risky of the two things. I would have avoided a lot of stress, though.

One participant discussed department advisors as having an impact on their academic adjustment, being particularly responsive and positive during times of distress.

4.5 Transfer versus native student experiences

We compared the experiences of transfer and native students both quantitatively and qualitatively.

We used a Wilcoxon rank sum test with continuity correction [26] to determine if there was a significant difference between native and transfer student responses for 6 underlying factors related to university experience and for academic adjustment and social adjustment. We used a Holm correction for the 8 factors we compared to account for Type I error with repeated testing [10]. We found no significant difference between responses to any of the factors relating to university experience or for social adjustment. We found a significant difference in response relating to academic adjustment, $p < 0.001$. We can interpret the test statistic $U = 8511.5$ as *Common Language* (CL) effect size by dividing the test statistic U by the product of the sample sizes of the non-parametric test [5, 8]. We can interpret the test statistic to say there is 68% chance that a random native student response reflects easier academic adjustment than a random transfer student response.

We conducted a post-hoc analysis on the 2 questions that make up the academic adjustment factor. These questions asked students to indicate the extent to which they agreed with the following statements: Q1) Adjusting to the academic standards or expectations at UW has been easy; Q2) I experienced a dip in grades (GPA) during my first semester at UW (question was reverse-coded). For Q1, we again used a Wilcoxon rank sum test and found a significant difference in responses between student types ($p < 0.001$). We interpreted the test statistic $U = 2155.5$ as a CL effect size to say that there is a 69% chance that a random native student more so felt that the adjustment to academic standards at UW was easy when compared to a random transfer student. For Q2, we find a significant difference of $p < 0.0001$. We interpreted the test statistic $U = 2417$ to say that there is a 78% chance that a random transfer student more so felt that they experienced a dip in their GPA the first term at UW when compared to a random native student. We reported on these results in the top half of Table 2.

This perceived difference in academic adjustment led us to compare self-reported cumulative GPAs of transfer and native students to understand if perceptions matched performance. The median self-reported GPA of transfer student respondents (3.60) was less than the median for native students (3.74), and the range of GPAs was wider and lower for transfer students even though there were far more native student respondents (see Table 1). We found a significant difference between reported GPAs of different student types ($p < 0.01$), interpreting $U = 2017.5$ to say that there is a 60% chance that a random native student reported a greater GPA than a random transfer student. This difference may be confounded by the fact that transfer students started later in the undergraduate degree and may have been taking more advanced and difficult courses than native student respondents who were only in their 1st and 2nd years.

Making direct comparisons between GPAs is difficult because there are different grading criteria in different courses. Assuming that students take similar courses in similar years, we compared to GPAs of students by current standing. Because almost all transfer student respondents were the equivalent of 3rd or 4th year undergraduates (92%, see Table 1), we only compared 3rd and 4th year undergraduates. After a Holm correction for repeated tests, we found that there was a significant difference between 3rd year undergraduates ($p < 0.05$). Interpreting $U = 374.5$, we can say that there is a 75% chance that a random "3rd year" transfer student had a lower GPA than a random 3rd year native student (see bottom half of Table 2). Still, GPA is cumulative, so coursework from previous years affected 3rd year native students' GPAs. Although GPAs were difficult to interpret because of varying coursework between student types, we do find a difference in GPAs between student types. Figure 1 shows the difference in distribution between transfer and native students' GPAs by number of quarters in the CS major.

Table 2: Statistical tests on academic adjustment and GPA. * denotes $p < 0.05$, ** denotes $p < 0.01$. * denotes $p < 0.001$.**

comparison	p-value	U	num. responses transfer	native
factor: academic adjustment	0.00030***	8511.5	48	260
Q1: academic adj. has been easy	0.0016*	2155.5	24	130
Q2: GPA dip 1st term	0.000019***	2417	24	130
reported GPA	0.0016**	2017.5	22	129
reported GPA: 3rd yr	0.013*	374.5	10	50

To further compare transfer and native students, we analyzed free response questions. We found that in nearly all respects, native and transfer students responded with similar sentiments. Both groups cited friendships and study groups as key factors during adjustment and also encouraged other students to seek out peers. Both groups gave advice of working hard and various studying tips. Both groups mentioned using the department advisors as a resource, and cited specific faculty as benefitting their experience.

Two clear sentiments that differed between native and transfer students relate to the transfer seminar and job/internship searches. Transfer students identified the transfer seminar as a factor that contributed to their successful adjustment, mentioning that it helped

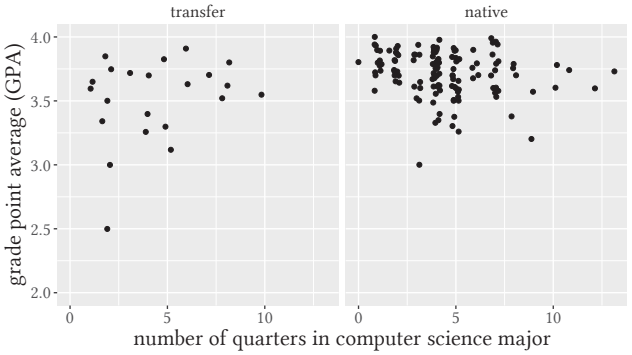

Figure 1: GPAs for native and transfer students by quarters in computer science major. The distributions of GPAs are different, but transfer and native students have different starting points (quarter 0), so direct comparisons are difficult.

them develop friendships and a community early on. Transfer students also discussed career planning and goals at a noticeably higher rate than native students: only three native students (2%) described seeking internships, while six of the 25 transfer students (24%) discussed thinking about internships early and using university resources to prepare for the job search. The importance of job opportunities to transfer students repeatedly appeared in the data.

5 DISCUSSION: FACTORS TO ADJUSTMENT

Our results showed that transfer students at UW were diverse:

- Many were first generation (44%).
- About 2 out of 3 were 21 years or older.
- About 2 out of 3 came from lower socioeconomic backgrounds or were financially independent.
- At least half lived further away from campus.
- Job opportunity was a major factor in their transfer decision.
- They generally felt satisfied with UW, a sense of belonging.
- They felt comfortable interacting with faculty and other students despite mentioning multiple barriers to social engagement (e.g. longer commutes, familial obligations).
- Multiple resources that UW offered (transfer seminar, counselors, career resources) helped their transfer process.

Despite confidence that their previous institutions prepared them well, transfer students still perceived greater difficulty in academic adjustment and had lower GPAs than native students.

There are many ways to interpret these findings. We sampled a self-selected subset of transfer and native students at UW, so this sample may not be representative. Comparing to the demographics of UW's CS department, we found that we ended up with an ethnically proportional sample of respondents, but slightly (+10%) oversampled students who identified as female. We only interviewed 8 (<10% of total) transfer students in UW CS. We also found no significant differences in UW experiences despite a difference in perceived academic adjustment, so the L-TSQ may not have been an appropriate survey instrument to detect differences that might have existed. Due to features unique to UW and its CS department, the generalizability of these results may be limited. Despite potential questions of respresentativeness, we triangulated across prior work, the L-TSQ, and interviews to identify trends.

Differences in cultural experiences between transfer and native students may be explained by differences in student attributes and preexisting capital. While some transfer students frequently engaged with the UW community, others noted age differences, long commute times, and familial commitments as barriers to engagement. For some, this may not have been an issue, due to short transfer distances and maintained friendships throughout the transfer process that provided preexisting capital. Indeed, most transfer students came from nearby institutions (<1 hr drive from UW, with at least 9 coming from institutions within 20 mins) and were older than native students, so they may have had social and cultural capital outside of the UW community. This may explain why 20% of transfer student respondents reported a feeling of belonging but *not* a feeling of community at UW.

Transfer students overwhelmingly felt that courses from their previous institution prepared them well, but also noted difficulty in academic adjustment. This may suggest that they were not well-informed about the transfer process. Less than half of transfer students found their previous academic advisors helpful and at least 1/3 of transfer students did not speak with UW counselors or visit UW campus before transferring. Many transfer students may have relied on researching information on their own, as 70% reported doing. Future work should further investigate resources to better inform and support the transfer process, such as a cohort-based model from community colleges to 4 year universities [22].

Our data also suggests that UW's CS department buffered students against even worse transfer shock. Transfer students found many of UW's resources helpful to their adjustment, including the transfer seminar, advisors, career resources, orientation, and cultural centers. Some students were reassured by the presence of resources even if they did not use them.

UW resources were not able to support all transfer students, as one transfer student respondent noted: "[the CS department] has done a good job of recruiting women and being inclusive but until [the CS department] does the same for underserved minorities (particularly black and latino students), tech will continue to be plagued with race/ethnic diversity issues and perpetuate the heightened feelings of imposter syndrome that these demographics feel." Interpreted in the lens of cultural capital, this lack of related cultural identity between students and faculty can hinder STEM students of colors, as prior literature has found [7, 24]. So while providing resources and opportunities to support transfer students is important, having a culture that connects with first-generation students and students across broad ranges of ethnicities, ages, socioeconomic statuses, and geographical locations may also support transfer student adjustment.

6 ACKNOWLEDGEMENTS

We have archived materials at:
https://github.com/codeandcognition/archive-2018icer-kwik.

This material is based upon work supported by the National Science Foundation under Grant No. 1703304, 1735123, 1314399, and 12566082.

REFERENCES

[1] Alexander W Astin. 1999. Student Involvement: A Developmental Theory for Higher Education. *Journal of College Student Development* 40, 5 (1999), 13.

[2] Peter Riley Bahr, Christie Toth, Kathryn Thirolf, and Johanna C. Massé. 2013. *A Review and Critique of the Literature on Community College Students' Transition Processes and Outcomes in Four-Year Institutions*. Vol. 28. Springer, Netherlands, 459–511. https://doi.org/10.1007/978-94-007-5836-0_10

[3] Pierre Bourdieu. 1986. *The forms of capital*. Greenwood, Connecticut, 241–258.

[4] Brent D Cejda. 1997. An examination of transfer shock in academic disciplines. *Community College Journal of Research and Practice* 21, 3 (1997), 279–288.

[5] R. N. Conroy. 2012. What hypotheses do âĂIJnonparametricâĂİ two-group tests actually test? *Stata Journal* 12, 2 (2012), 182–190.

[6] Patricia E Diaz. 1992. Effects of transfer on academic performance of community college students at the four-year institution. *Community/Junior College Quarterly of Research and Practice* 16, 3 (1992), 279–291.

[7] Lorelle Espinosa. 2011. Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences That Contribute to Persistence. *Harvard Educational Review* 81, 2 (Jun 2011), 209–241. https://doi.org/10.17763/haer.81.2.92315ww157656k3u

[8] Robert J. Grissom and John J. Kim. 2012. *Effect Sizes for Research: Univariate and Multivariate Applications, Second Edition*. Routledge, London.

[9] John R Hills. 1965. Transfer shock: The academic performance of the junior college transfer. *The Journal of Experimental Education* 33, 3 (1965), 201–215.

[10] Sture Holm. 1979. A Simple Sequentially Rejective Multiple Test Procedure. *Scandinavian Journal of Statistics* 6, 2 (1979), 65âĂŞ70.

[11] Shanna Jaggars, John Fink, and Jeffrey Fletcher. 2016. *A longitudinal analysis of community college pathways to computer science bachelor's degrees*. Technical Report. Google.

[12] Frankie Santos Laanan. 2004. STUDYING TRANSFER STUDENTS: PART I: INSTRUMENT DESIGN AND IMPLICATIONS. *Community College Journal of Research and Practice* 28, 4 (Apr 2004), 331–351. https://doi.org/10.1080/10668920490424050

[13] Frankie Santos Laanan. 2007. Studying Transfer Students: Part II: Dimensions of Transfer Students' Adjustment. *Community College Journal of Research and Practice* 31, 1 (Jan 2007), 37–59. https://doi.org/10.1080/10668920600859947

[14] Frankie Santos Laanan, Soko S. Starobin, and Latrice E. Eggleston. 2010. Adjustment of Community College Students at a Four-Year University: Role and Relevance of Transfer Student Capital for Student Retention. *Journal of College Student Retention: Research, Theory & Practice* 12, 2 (Aug 2010), 175–209. https://doi.org/10.2190/CS.12.2.d

[15] Nan Lin, Karen S. Cook, and Ronald S. Burt. 2001. *Social Capital: Theory and Research*. Transaction Publishers, New Jersey.

[16] Louise Ann Lyon and Jill Denner. 2016. Student perspectives of community college pathways to computer science bachelor's degrees.

[17] Jennifer Ma and Sandy Baum. 2016. *Trends in community colleges: Enrollment, prices, student debt, and completion*. Technical Report. College Board.

[18] Jane Margolis and Allan Fisher. 2003. *Unlocking the clubhouse: Women in computing*. MIT press, Cambridge, MA.

[19] Lisa Massi, Patrice Lancey, Uday Nair, Rachel Straney, Michael Georgiopoulos, and Cynthia Young. 2012. Engineering and computer science community college transfers and native freshmen students: Relationships among participation in extra-curricular and co-curricular activities, connecting to the university campus, and academic success. In *Frontiers in Education Conference (FIE), 2012*. IEEE, IEEE, New York, 1–6.

[20] Jacqueline C McNeil, Matthew W Ohland, and Russell A Long. 2016. Entry pathways, academic performance, and persistence of nontraditional students in engineering by transfer status. In *Frontiers in Education Conference (FIE)*. IEEE, IEEE, IEEE, 1–7.

[21] Kristin M. Moser. 2012. *Redefining transfer student success: Transfer capital and the Laanan-transfer students' questionnaire (L-TSQ) revisited*. Ph.D. Dissertation. Iowa State University. https://search.proquest.com/docview/1022973592/abstract/3A54323230EC4F85PQ/1

[22] Sathya Narayanan, Kathryn Cunningham, Sonia Arteaga, William J. Welch, Leslie Maxwell, Zechariah Chawinga, and Bude Su. 2018. Upward Mobility for Underrepresented Students: A Model for a Cohort-Based Bachelor's Degree in Computer Science. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education (SIGCSE '18)*. ACM, New York, NY, USA, 705–710. https://doi.org/10.1145/3159450.3159551

[23] University of Washington Office of Academic Data Management. 2017. Quick Stats of Student Enrollment | UW Student Data. https://studentdata.washington.edu/quick-stats/. "Accessed 6 June 2018".

[24] Maria Ong, Carol Wright, Lorelle Espinosa, and Gary Orfield. 2011. Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics. *Harvard Educational Review* 81, 2 (Jun 2011), 172–209. https://doi.org/10.17763/haer.81.2.t022245n7x4752v2

[25] Ernest T. Pascarella, Christopher T. Pierson, Gregory C. Wolniak, and Patrick T. Terenzini. 2004. First-Generation College Students: Additional Evidence on College Experiences and Outcomes. *The Journal of Higher Education* 75, 3 (2004), 249–284. https://doi.org/10.1353/jhe.2004.0016

[26] Judy Robertson and Maurits Kaptein. 2016. *Modern Statistical Methods for HCI*. Springer, New York, NY, USA.

[27] Soko S. Starobin, Dimitra Jackson Smith, and Frankie Santos Laanan. 2016. Deconstructing the Transfer Student Capital: Intersect between Cultural and Social Capital among Female Transfer Students in STEM Fields. *Community College Journal of Research and Practice* 40, 12 (Dec 2016), 1040–1057. https://doi.org/10.1080/10668926.2016.1204964

[28] Margaret D Sullivan, Clemencia Cosentino de Cohen, Michael J Barna, Marisa K Orr, Russell A Long, and Matthew W Ohland. 2012. Understanding engineering transfer students: Demographic characteristics and educational outcomes. In *Frontiers in Education Conference (FIE), 2012*. IEEE, IEEE, New York, NY, USA, 1–6.

[29] Jennifer Wang, Sepehr Hejazi Moghadam, and Juliet Tiffany-Morales. 2017. Social Perceptions in Computer Science and Implications for Diverse Students. In *Proceedings of the 2017 ACM Conference on International Computing Education Research*. ACM, 47–55.

[30] Paul E. Willis. 1977. *Learning to Labor: How Working Class Kids Get Working Class Jobs*. Columbia University Press, New York, NY, USA. Google-Books-ID: 3zmVaLrGIDEC.