"A field where you will be accepted": Belonging in student and TA interactions in post-secondary CS education

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ABSTRACT

Motivation. All students studying Computer Science (CS) deserve to feel a sense of belonging. In a post-secondary CS class, undergraduate Teaching Assistants (TAs) have the majority of student contact hours, making student-TA interactions, such as those during office hours, important in shaping student belonging. Therefore, we sought to understand student and TA conceptions of belonging, their narratives about their journeys of belonging in CS, and how TAs influence student sense of belonging through office hour interactions.

Methods. We studied students and TAs at a large North American university in 4 CS courses, including introductory, intermediate, and advanced; core and elective, interviewing them about their belonging in post-secondary CS. We conducted semi-structured 1:1 interviews with 14 participants, consisting of 7 pairs of students and TAs who interacted in office hours.

Results. Student and TA conceptions and narratives of belonging aligned with the three basic needs for wellness as described in Self-Determination Theory: relatedness, competence, and autonomy. Some also surfaced needs for safety and access as key components of belonging. TAs and students reported that TAs supported student needs for competence, relatedness, and autonomy by fostering understanding of material, treating them with empathy, helping them see peers positively, and helping them to own their own success.

CCS CONCEPTS

• **Social and professional topics → Computing education**.

KEYWORDS

CS Education, Belonging, Teaching Assistants, Post-Secondary, Office Hours

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1 INTRODUCTION

Belonging has long been established necessary toward thriving in organizations, communities, and learning settings. Fundamentally, belonging is a basic human need [8, 38]. It is important in school [20, 24, 59], and it drives motivated behavior [16], including at school [24, 25].

Computing education is no different; prior work on post-secondary shows that peers matter, culture matters, content matters, especially for students from marginalized groups. For example, peer relationships are connected to performance [60] and career choice [52]. Peer relationships especially matter for students from groups marginalized in CS [48, 52]. When it comes to culture and climate, perceived culture of CS influences belonging [33], climate relates to the formation of hierarchies among CS students [6], and even physical environments influence student interest in CS along gender lines [14]. Culture and belonging contribute to a structural pattern of retention in CS: those who feel they belong choose to continue, normalizing the culture that filtered for them in the first place [61]. Teaching students about inclusion itself can make a difference for retention [34, 61].

Emerging work, however, suggests that teaching assistants (TAs) may be of particular importance. For instance, in a study examining TAs acting as community facilitators, students reported a greater sense of community [4]. TA behavior can play an important role in shaping where students get help with programming problems [32]. Having 'relatable' TAs and TAs as mentors are inclusive factors for women of color in CS [56].

While prior work makes clear *that* TAs matter, it has not yet examined *how* TA identity and behavior shape belonging. For example, it may be that shared racial or gender identity with TAs is central. Or, it may be that TAs' interpersonal behavior is the key mechanism for shaping belonging. Or, it could be that in CS, TAs' most important contribution is simply to be more available for programming help than faculty. Or it could be that all of these interact to promote or erode a sense of belonging. Because these

possibilities have not been explored, it is difficult to inform how TAs should be trained and supported to promote belonging.

To address this gap, in this paper we focus on the specific context of office hours. These are where students and TAs often interact most directly, so they offer a granular lens on how students experience TAs and their behavior, but also how TAs intend that behavior. We ask three questions about these contexts:

- RQ1: How do both students and TAs conceptualize belonging, both through direct descriptions of what belonging is, and through narratives about their journeys of belonging in CS?
- RQ2: What do TAs do to try to promote the student's sense of belonging in CS office hours?
- RQ3: What do students perceive TAs doing during office hours, intentionally or unintentionally, that shapes their sense of belonging in CS spaces?

To answer these questions, we observed office hours and then conducted semi-structured 1:1 interviews with 7 pairs of TAs and students who had recently interacted in office hours. In interviews, we asked them to describe their narratives of belonging in CS, their concept of belonging, and to explain any connections between office hour experiences and belonging.

2 BACKGROUND

Belonging has been studied and theorized about extensively, both in general and in CS.

2.1 Theories of Belonging

Many varying but interrelated concepts of belonging exist across and within disciplines. Mahar et al. review trans-disciplinary concepts of belonging [36]. One example is the Hagerty concept of "general" belonging, measured by the widely used Sense of Belonging Instrument (SOBI) [27]. This instrument defines belonging as "the experience of personal involvement in a system or environment so that persons feel themselves to be an integral part of that system or environment," including two distinct attributes of sense of belonging: "valued involvement or the experience of feeling valued, needed, or accepted" and "fit, the perception that the individual's characteristics articulate with the system or environment." Goodenow presents an alternative definition a learning context as "sense of being accepted, valued, and encouraged by others... feeling oneself to be an important part in the life and activity of the class" [25]. This work has been widely used in schools to measure belonging with the *Psychological Sense of School Membership* (PSSM) scale [26].

Some work links belonging to fundamental human needs. For example, Bauminster's "belongingness" hypothesis posits belonging is a basic human need [8], and has linked it to theories of human need hierarchies, such as Maslow's [38], which put needs like belonging as less important than other more basic needs, such as physiological and safety needs. Other models of human needs are flatter, but still place social needs such as belonging higher than physiological needs [23, 24]. In models of human motivation, belonging features as a component of key needs that motivate behavior [16, 23, 24]. Work on belonging in human needs finds that while internal thoughts can affect the person's belonging [3], things outside of a person are just as important [11]. For example, Josselson describes 8 dimensions of the human need for "relatedness," including "embeddedness" which is "to be embedded within a social network is to feel included, to share characteristics, to be the same as, to give up some individuality in the interconnection... embeddedness implies a sense of belonging" [29, 30].

Theories of belonging in post-secondary education often relate belonging to student adjustment and retention in post-secondary institutions [2, 54]. For instance, according to Tinto's institutional departure model, students must be integrated socially and academically into their college environment, otherwise it could lead to departure [2, 59]. Belonging to one's institution and belonging in a certain classroom are two separatable concepts [20]. Belonging in a classroom is associated with academic self-efficacy, intrinsic motivation, how much students value class activities, and perceptions of their instructor, whereas institutional belonging is associated with social acceptance [20].

The macro-theory of *Self-Determination Theory* (SDT) ties together ideas from other theories about belonging and human psychological needs. SDT identifies three basic psychological needs: *competence*, "to engage optimal challenges and experience mastery or effectance in the physical and social worlds," *relatedness*, "to seek attachments and experience feelings of security, belongingness, and intimacy with others," and *autonomy*, "to self-organize and regulate one's own behavior"[16]. When these three needs are satisfied, one can experience psychological wellness and autonomous motivation [16]. SDT places belonging as a subcomponent of the need for relatedness [16]. However, colloquial concepts of belonging could connect more expansively to different concepts within SDT. For example, when asking a student "do you feel like you belong in computing," they could interpret it as "are you able to perform highly and succeed in computing" [60] (competence), "is everything ok for you in computing" (psychological wellness), or "do you want to keep studying computing" (autonomous motivation). Therefore, we draw on all these concepts from SDT to inform our work.

2.2 Related Work

Prior research on belonging in post-secondary CS education has mostly not drawn upon particular theories, but has revealed empirical patterns consistent with the theories above. For example, some prior work on post-secondary CS defines belonging as how students see themselves in relation to their ability to perform or succeed in the discipline [60], to the objects in the environment [14]; to the peers "imagined to occupy the environment" [14], to how they perceive others see them [41], to how they feel welcomed [60] and to how they feel valued [41]. Notably, the concept of CS *ability* appears explicitly in post-secondary CS education literature on belonging. Since an academic environment centers on students building knowledge, and since a defensive climate, in which students form social hierarchies based on their knowledge, is prominent in CS environments [6], this could be understood as a discipline-specific example of the more general idea of "fit" with the environment and with others.

Prior studies of belonging in post-secondary CS reveal many factors shaping it [51]. Physical objects in an environment can have a gendered impact on belonging [14]. A student's culture and the culture of the CS academic space can also impact belonging [6, 21,

33]. Peers, academic performance, and self-efficacy all interact to impact belonging [60]. Peer relationships are especially important for students from marginalized groups in CS [48, 52]. Belonging and persistence in computing connect to social power structures of race and gender; many inclusion interventions ignoring these power structures have failed [48]. Faculty may teach students about issues affecting marginalized students [61] or alternative narratives to stereotypes about computer scientists [34] in an attempt to impact their sense of belonging and, more broadly, elements of computing culture that shape belonging. Participation in networking, outreach, and mentoring may raise belonging for women [41].

Studies of post-secondary CS also demonstrate how Self-Determination Theory's themes of competence, relatedness, and autonomy interact with belonging. For example, a sense of belonging in academic peer groups and non-academic communities of academic peers or family can help students perform better in course work (competence) [60]. Peer relationships (relatedness) are associated with performance (competence) [52]. And interventions to increase student autonomy can improve engagement, performance, interest, self-confidence, and belonging [13].

Prior work establishes the important role of TAs is belonging, but the mechanisms of their impact are not yet well examined [40]. Most prior work has been from an instructor and managerial perspective, examining how to support TA professional growth [31, 45, 55], how to structure TA management and retention programs [17, 18, 44, 46], how to leverage TA efforts to facilitate learning and student retention [9, 10, 12], and TA training [5, 19, 39, 49]. Only a handful of works examine TA perspectives, studying peer tutoring [37] and pedagogical challenges [50], but these do not address student belonging.

Recent prior work not explicitly about belonging has shown indirectly that TAs contribute to belonging. In work by Kuperwajs-Cohen, CS1 students reported that factors such as judgment, intimidation, familiarity, and trust impact their decisions to get academic help from sources including their TAs [32]. Work by Tari et al. on experiences of Asian and Pacific Islander experiences in CS [56–58] showed that TAs' identities and behavior impact CS students' belonging, with TAs particularly lamenting lack of guidance on supporting students from underrepresented groups.

While the substantial prior work on belonging in CS and in general establishes that TAs shape belonging, prior work has not yet examined how TA identity and behavior does this shaping.

3 METHODS

In this study approved by our university's institutional review board, we conducted semi-structured 1:1 interviews with 14 participants, consisting of 7 pairs of TAs and students who had interacted with each other in office hours, with interviews occurring as soon as possible after their office hour interaction.

3.1 Context

The study took place at the Paul G. Allen School of Computer Science and Engineering (Allen School), at the University of Washington (UW), a large, public, North American university. We recruited participants from four undergraduate CS courses, displayed in table 1. During the summer term of the study, most courses in the department enrolled fewer students than during the academic year, and it was easier for non-majors to enroll in CS major courses, but course content was the same. Campus-wide data suggested that summer courses enrolled fewer international students, due to higher tuition. Despite smaller enrollment, courses were structured similarly to academic year offerings of the same courses enrolling up to 250 students. As during academic year offerings, typical TA duties included grading, office hours to help students with classwork, teaching weekly "recitation" sections reviewing content in smaller groups, and weekly staff meetings for the instructor and TAs to discuss course logistics It was common practice in the department to offer summer lead instructor roles to students. Of participating courses, one instructor was a doctoral student, one was a Master's student, and two had graduated from the program with a Bachelor's degree just before teaching.

The CS department encouraged TAs to enroll in a paid TA training seminar during their first term as a TA, meeting one hour per week. The primary seminar audience was new undergraduate TAs, and topics included professionalism, ethics, teaching scenarios, teaching and learning, grading, feedback, academic integrity, active learning, and restructuring a recitation section [1]. Of TAs in the study, two had attended all sessions, two had attended fewer than half, two did not attend, and one did not report.

3.2 Recruiting Instructors and TAs

First we recruited instructors, requesting permission to recruit TAs and students. The first author recruited instructors teaching undergraduate CS courses during the summer 2022 academic term, who the first author perceived would be open to the study, based on prior indicators of interest in inclusion. For each course, the first author visited the staff meeting to describe the research to TAs and recruit TAs. The instructor stepped out of the staff meeting so as not to know which TAs volunteered for the researcher to visit their office hours. Then the first author visited class to describe the study and ask students to participate if they showed up to a participating office hour. Students and TAs were informed that their participation would not impact employment or class standing and that the researchers would not apprise the instructor of participant identities.

Recruitment messages expressed the researcher's interest in talking to participants who identified with minoritized groups or had experienced fluctuations in belonging. TA recruitment messages were designed to appeal based on interest in inclusivity and belonging. This feature means the study data primarily reflect TAs working to create positive climates of belonging. Another feature of the recruitment design is paired recruitment of TAs and students, producing data exposing multiple perspectives of the same interactions. As a side effect, each participant knew their paired counterpart was in the study, and students did not express much negative feedback about their paired TA.

3.3 Recruiting and Selection

The first author observed each TA's office hours once or twice during the term, primarily for recruiting students to the study. The researcher and TA met for 10-15 minutes before a mutually agreed upon office hour. The researcher coordinated with the TA to

Course	Undergraduate level[1]	TAs	Students	Study participants
CS2 for data science	Introductory	9	58	S5, T5, S7, T7
Probability and statistics *	Intermediate	6	46	S6, T6
Computer organization *	Intermediate	4	50	S3, T3, S4, T4
Machine learning for non-majors	Advanced	5	42	S2, T2, S9, T9

Table 1: Courses participating in the study, levels as listed in the course catalog, number of TAs employed, number of students enrolled at the conclusion of the term, and IDs of study participants in that course. Asterisks (*) denote courses for CS majors, where students not admitted to the major needed special permission to enroll.

incorporate the study procedure into the TA's office hour, following the TA's preferences and preferred office hour practices. Office hour observations were spread over 2 weeks toward the middle of the term.

Office hours took place virtually by video call or in academic building breakout areas. Breakout areas were lounge-like study spaces with whiteboards, tables, chairs, and couches, accommodating about 10-20 people. Breakouts were commonly reserved by TAs for office hours, but students from other courses often also used the space during office hours. In virtual office hours, the TA created a private virtual room to help each student one-on-one while other students waited together in a non-private virtual room.

During office hour observations, the TA introduced the researcher to each student at the start of the student's turn, asking permission for the researcher to observe. After obtaining permission, the researcher assumed a non-invasive presence to minimize observation bias while listening to the interaction and taking notes. On video call, this meant turning off camera and microphone. In breakout rooms, this meant sitting within earshot. either across the table or a few seats away, keeping a distance similar to students who were waiting their turn. The researcher observed by listening rather than watching most of the time, taking notes on a laptop. Students and TAs hardly looked at, talked to, or otherwise acknowledged the researcher, and did not appear to be distracted by them during the office hour interactions.

At the end of the student's turn, the researcher offered to answer questions about the study, and asked the student to fill out a survey about their identity and office hour interaction (table 2a). Meanwhile, the TA filled out a survey about the interaction, (table 2b). At the end of the office hour, the researcher offered to answer questions from the TA and the TA filled out a survey about their identity and experience level as a TA (table 2c).

Responses were captured as free text, except where indicated. Questions were optional except where indicated. Instructions on each survey included an estimate of the time required and brief description of the purpose. Surveys contained a link to study information, including researcher contact information and confidentiality statement. Survey data were used as selection criteria for interview invitations, and to help participants remember details of the office hour while interviewing, but were not used directly in the analysis.

[1]Introductory courses were academically accessible to first year students, intermediate courses were designed to be taken towards the middle of a four-year degree, and advanced courses towards the end.

3.4 Interviews

The first author communicated with prospective interviewees and conducted interviews over a 2 week period near the middle of the term.

We selected who to invite for interviews based on survey data. We prioritized inviting:

- Students with longer, more detailed responses to the question about how the office hour interaction influenced belonging.
- Participants identifying differently from those already scheduled to interview, to have a diverse set of genders, ethnic identities, and abilities represented in the study.
- Students taking different courses than students already scheduled to interview.
- TAs with different self-reported levels of TA experience than TAs already scheduled to interview.

We sent interview invitations to students the same day as the observed office hour or the next day whenever possible. Multiple students filled out the survey for most of the TA office hours, but we only interviewed up to 1 student for each TA. First, we invited our top choice interviewee. If they declined, we invited the next choice. To reduce delays from declined interviews, we prioritized inviting the most interested participants. After a student scheduled their interview, we invited the paired TA. We tried to schedule interviews as soon as possible after observed office hours as scheduling constraints allowed. 10 participants interviewed 1-2 days after, and 4 participants interviewed 3-5 days after. To mitigate effects of forgetting interaction details, the interviewer showed participants their survey responses. We offered interviewees a preference between in-person and video call, with in-person interviews held in a private user study room.

We conducted semi-structured interviews in English, and recorded audio with participant consent. Given the format, there were differences in question phrasing, building on context established with each interviewee, and different probing questions to satisfy the researcher's curiosity about all topics in the interview guide. Interviews ranged from 30-80 minutes in duration, with most interviews lasting about 1 hour. Table 3 summarizes questions.

In interviews, we did not provide a definition of belonging because we did not want to bias participants and restrict them to only telling narratives that matched the researchers' definition of belonging. Instead, we asked participants to define belonging about halfway through the interview, after talking about their journey of belonging in CS, so they had context to structure their definition.

Student Office Hour Survey (5 minutes)
[Page 1] Belonging and CS TAs research study • Name (required) • Based on this survey, you might be invited to a 30-50 minute interview to share more details about this office hour interaction and your sense of belonging in the course. Your privacy will be protected, and you will be paid for your time interviewing. If invited, do you think you might be interested in interviewing? (required) [Multiple choice] — Yes / most likely [leads to page 2] — Maybe / not sure [leads to page 2] — Definitely not [leads to end of survey]
[Page 2] Your Office Hour Conversation • TA Name • Write a couple sentences briefly summarizing the interaction you had with your TA just now. (required) • Briefly describe how this conversation impacted your sense of belonging in the course. (required)
[Page 3] Your Identity • **[Identity Questions]**

(a) Student survey.

TA Identity and Experience Level Survey (2 minutes)
• How would you describe your experience level as a TA? (required) Include teaching-related experience from this course and other courses, both at UW and outside UW. • **[Identity Questions]**

(b) TA identity survey.

TA Office Hour Survey (2 minutes)
• Student name if you know it • Write a couple sentences briefly summarizing the interaction you had just now with the student named above. (required) • Briefly name things you did to try to help the student feel a sense of belonging. (required)

(c) TA office hour survey.

Table 2: Office Hour Surveys. Surveys 2a and 2b also included identity questions to self-describe gender, ethnic identity, languages spoken at home, and disabilities.

After producing each major draft of this paper, the authors engaged interviewees in a member check to validate that the manuscript accurately represented them and elicit corrections. All participants validated both drafts the manuscript, including 4 who made minor corrections to the first draft, and 2 to the second draft.

TAs were compensated by gift card, or as part of their TA paycheck, depending on instructor and TA preferences. Hourly TAs received their standard TA pay rate, $17.79-$21.79 per hour. Salaried TAs were paid at the top of that range. Student interviewees were paid $17.79 per hour by gift card.

3.5 Participants

There were 14 interview participants, consisting of seven pairs of students and TAs who interacted during the observed office hours. Participant names have been replaced with participant IDs for anonymity. Participant pronouns have been replaced with participant IDs or the generic pronoun "they" since we did not ask for pronouns. Participants who shared an office hour interaction share the same number, while letter indicates role in office hour interactions: 'S' for student and 'T' for TA. One TA was a PhD student and the other participants were undergraduates, including five CS majors. Five participants reported CS experience before college. Table 4 displays participants' self-described gender and self-described ethnicity and table 1 shows each participant's course.

3.6 Analysis

The second author transcribed interviews using otter.ai, an automated transcription web tool. To establish soundness in our analysis, two researchers contributed to coding. Both developed a code book using not only inductive themes from interview content, but also

Template
• Why did you choose to participate in this research study? • Describe your journey of belonging in this course. • How do your identities tie in with your journey of belonging in CS spaces? • In what we just talked about, what is your definition of belonging? • Tell me your story of how the observed office hour went for you. [TA- or student-specific questions] • Do you have any questions for me?

(a) Interview guide template.

Student
• What did the TA say or do during this interaction that increased/decreased your sense of belonging in this course? • If a new TA asked you for advice from your perspective as a student on what to do/not to do to help students feel a sense of belonging, what would you tell them?

(b) Student-specific questions.

TA
• What did you say or do during this interaction to try to help the student feel a sense of belonging? • What do you do in general as a TA to help students feel a sense of belonging? • If a new TA asked you for advice on what to do/not to do to help students feel a sense of belonging, what would you tell them? • What value is there in students developing a sense of belonging in CS spaces? • Do you see it as part of your job to help students develop a sense of belonging?

(c) TA-specific questions.

Table 3: Interview questions. The interview guide template (3a) was used for all interviews, with student-specific (3b) or TA-specific (3c) questions, depending on interviewee.

deductive themes derived from research [15, 53]. The first and second author coded transcripts, using agreement through consensus rather than inter-rater reliability to ensure consistency [28]. Both coded one transcript together. Then the first author coded a second transcript while relying on the second author to resolve many uncertainties. By this point the first and second authors had arrived at a shared understanding of codes. Then the first author coded the rest independently, consulting the second author on occasional uncertainties. The first author then applied thematic analysis to coded transcripts.

After receiving feedback and reading more background literature, the authors re-coded transcripts with additional themes informed by literature. The first and second author jointly selected new themes. The first author re-coded transcripts, consulting the second author to resolve uncertainties. The first author then applied thematic analysis to revise and add to the first analysis draft.

Aggregated across both coding rounds, autonomy codes were the most uncertain because of ambiguities around how the definition of autonomy from SDT manifested in the data. Competence and relatedness codes had some uncertainty because it was sometimes unclear if a quote was sufficient to justify coding it under those themes.

3.7 Positionality

The first author is a culturally Jewish white woman and approached this research as (1) a former undergraduate and TA at a small liberal arts college CS department, where she obtained a Bachelor's degree in CS and (2) a PhD student and current and TA at the university CS department where the study took place. Her motivation to conduct this research arose in part from seeing room for improvement in the undergraduate TA program at the university. She played a lead role in the research, designing and executing the research methods with support from the other authors.

The second author approached this research as (1) a former undergraduate in a large, public, research-intensive university in the US with an established TA training program (similar to this study's context) and (2) a former TA in her undergraduate and graduate studies. As a member of several marginalized groups in computing, she experienced both positive and negative interactions in both

ID	Gender	Ethnicity
S2	Female	Korean
T2	Cisgender Male	Taiwanese-American
S3	male	vietnamese
T3	Male	South Asian
S4	Cis Male	Latino
T4	trans man	white
S5	Female	I think Asian or a mix of American and Asian
T5	Cisgender Female	Korean American
S6	Male	Caucasian
T6	Female	mixed race Chinese and Caucasian
S7	Female	Asian
T7	Male	Asian
S9	Genderfluid	East Asian
T9	male	white/caucasian/german

Table 4: Participants' self-described gender and self-described ethnicity. Capitalization and punctuation are as participants wrote them.

positions. She played a supporting role in the research, collaborating with the first author on data analysis and interpretation.

The third author is a computing education researcher and professor with interests in diversity, equity, and inclusion in computer science learning contexts. She was positioned in this work as an advisor, providing guidance on research and methods, but not directly engaged in data collection or analysis. She approached this work with some curiosity about student and TA perspectives about their mutual interactions, but not with a particular a priori hypothesis about what they might say. She approached the research question from a place of ignorance, having never attended a CS office hour when she was an undergraduate in CS.

4 RESULTS

In interviews, students and TAs described their concepts of belonging in CS. Their belonging needs aligned with fundamental needs for safety and resources and with the three basic needs of SDT: relatedness, competence, and autonomy (RQ1). They also described TA actions addressing those needs (RQ2, RQ3).

4.1 Concepts of Belonging

Participants described a diversity of conceptions of belonging (RQ1), most mirroring prior work; interactions between students and TAs revealed numerous aspects of communication, pedagogy, and identity that shaped belonging. Note: quotations below represent parts of participants' concepts matching each theme, not necessarily each participant's entire concept of belonging.

4.1.1 Competence. As members of an academic community centered around CS knowledge, students' competence greatly influenced their belonging.

The theme of competence arose frequently, sometimes in combination with safety. In T9's concept of belonging, competence came up as its own component: "*to feel like you can be successful.*" Others described safety as interconnected with competence. For instance, S2 said that belonging was feeling "*safe enough to ask questions and have that maximum potential to learn something,*" and T2 described it as "*not feeling like you're going to be alienated or made fun of or put down if you reach out for help.*" S6 articulated how lack of safety around group competence could inhibit belonging, saying:

> "not belonging... is where the people are very guarded, closed down... someone asks a question, no one raises their hand because no one wants to take a risk of being seen as wrong or judged."

Participants described how their own prior knowledge could contribute to belonging (S6, T2), while lack of prior knowledge relative to peers could detract from belonging (S3, S4, S6, S9, T2, T4, T9). Some noted how acknowledging everyone's differing skill levels and that experienced peers also struggled could mitigate this (S6), as could receiving encouragement from the instructor (S4).

Many students described learning as another facet of their competence. For example, participants reported feeling greater belonging as they noticed their progression through the course material (S3, S4, S9). They also indicated that performance, measured by grades (S3, S4, T3, T4, T9), and self-efficacy contributed to their belonging (S4, S5, T2, T4, T9). For S4, a first generation[2] university student, self efficacy helped overcome doubts related to identity.

> "The fact that I got a really good grade for [CS1] let me know that I wanted to study computer science. It also reinforced the fact that I felt confident in my ability to do it in the first place. Regardless of the notion that not many Latinx individuals are in tech."

T9 described a connection between competence and relating to others through teaching and peer review, which supported belonging:

> "They review your work, they accept it, they publish it. ... Teaching has helped with that as well. Because over time, I mean, you're literally like the person communicating to a new person, what this field is about."

Students who did not start their university CS education in a 4-year institution noted the importance of certain prerequisites for competence, and how lacking those harmed belonging. T9, who started CS as a graduate student with an undergraduate degree in humanities, used the term "hidden curriculum" to describe this phenomenon, saying,

> "IDEs and editors, like vim or Emacs. Often these things are not taught, or they're taught in a cursory way. ... Those were huge stumbling blocks."

Similarly, S6, who transferred from a 2-year community college, said:

> "There should be a tutoring center for the [intermediate] classes. ... If you see no path between here and there, then that can be crushing and demoralizing in all sorts of ways."

S6 envisioned that the tutoring center, unlike office hours, would focus on study skills.

[2] *first generation* refers to a university student whose parents did not go to university

4.1.2 Relatedness. Among the predominant components of the need for relatedness were needs for safety, community, and positive self image relative to peers.

Participants most frequently conceptualized belonging in terms of relatedness – ways they socially connected to peers and instructors. T6 conceptualized belonging as contribution with "*you have a place... you're contributing to the energy that the group has.*" Some conceptualized belonging as others' reception, saying "*if you don't come to that class, you feel like people are missing out on you*" (S9), that belonging is a feeling that CS is "*a field you're where you will be accepted*" (T4), and that "*you are valued or at least tolerated or permitted*" (T9). S4, who had reported being the only Latinx person in the room, described the opposite of belonging as "*if you feel like everybody knows each other, whereas you're the only one, that can sometimes be isolating.*" S6 shared a collective concept of belonging, saying "*among a group of people things are working smoothly and as expected.*" S7 characterized belonging in terms of course staff, indicating that belonging was high when the "*instructor and TAs... actually care about their students.*" In some concepts of belonging, relatedness was interconnected with competence. S3 described belonging as feeling "*confident enough to tell [peers] my implementations,*" and S6 described it as being "*unified in your ignorance.*"

Students reported fear and discomfort associated with office hours and classrooms, revealing a need for TAs to actively make a safe space. For example, participants observed that when TAs put students down with condescending, dismissive, or disparaging remarks, it harmed belonging (S3, S4, S6, S9, T2, T3, T5, T6, T7). T4 explained that telling students they should know something signaled both non-acceptance and a belief that they could not succeed, connecting to both relatedness and competence. S2 reported a profoundly uncomfortable experience with an organic chemistry TA:

> "I was just sitting there asking very basic questions and he would literally just stare at me. For so long.... I felt like I was being picked on. ... He would kind of say things like like 'we literally just went over it.' ... And it just made me feel so uncomfortable."

They contrasted it with feeling much safer with a more responsive TA. S5 described feeling nervous and paranoid about going to CS office hours, concerned that their question would be too small, uncertain whether they could articulate the question, and "*very uncomfortable about taking my TA's time.*" S3, a first generation student new to CS in university said, "*Being from my background, not knowing much computing... a lot of students are scared of their first programming class*" S3 described taking a first intermediate CS class, where classroom social dynamics alleviated fear of incompetence they had felt in CS1 and CS2:

> "[the instructor] made sure that the classroom was like a safe environment. And he encouraged like talking to other people. ... The TAs are just way more approachable. ... I wouldn't feel scared about like, Okay, do I know this content before I even he even jumps into it"

T2 equated belonging with not being judged, saying:

> "Your TAs or professors who for sure know more than you are going to help you, and not judge you."

S6 described how being older than peers emboldened them to take a risk in a classroom situation where members feared judgment:

> "No one raises their hand, because no one wants to take a risk of being seen as wrong, or judged. ... Since I'm sort of an older outlier anyway, I will usually jump in and just take one for the collective team. Ask the dumb question."

Participants indicated that knowing people in their community could contribute to their sense of belonging. Students shared that their networks grew as they spent time at university (S3, T3, T7), perhaps starting with people they had known before college (S3, T3). T3, who is from Malaysia and only knew Malaysian students at first, started out knowing few people. Students described how meeting more people promoted a sense of community and increased belonging in CS (T3, T4). They noted this could be true even if the people were outside CS spaces. For example T2 described the impact of taking CS courses with statistics cohort peers:

> "I think especially like being with like a stat cohort as well, even though that's an external factor to CS, I felt that that still helps me feel like a sense of belonging."

Apart from knowing and interacting with real people, participants described how they could form negative perceptions of themselves relative to others, based on real or imagined characteristics, and how these comparisons could detract from belonging by making them feel isolated. S4, a first generation student new to CS in university, who was not a CS major but was taking a CS majors course as a senior[3], shared feeling uncertainty when comparing to CS majors, saying

> "At the beginning [of this term], I wasn't very sure if I would continue it because I felt like a lot of CS majors already kind of knew what was going on, even if they didn't."

S3, also a first generation student new to CS in university, described feeling intimidated in a CS2 class during their first year, by peers demonstrating prior knowledge, saying

> "There's so many people in this class... that pretty much know everything. And they're just feeding the teachers answers. And I'm just stuck, just trying to like understand what the teacher or the student was trying to say 10 minutes ago."

Making negative comparisons to peers was not a pattern reserved for beginners or students new to CS in university. For example, T4, a final-year undergraduate CS major who had taken CS courses in middle school and high school (ages 12-18), described presently regretting a lack of internship experiences, saying:

> "I've never done a summer internship. And that feels like it's expected here. You know, especially like you overhear people in the hallways talking about like, Oh, I'm going to Facebook. I'm going to Microsoft."

S3 expressed the difficulty of stopping mental comparisons, connecting this negative self talk with lack of belonging. In S3's words,

> "Once I have this feeling of just not comparing myself with other students, it's very hard to not do that right

[3]A *senior* is a student in their final year of a four year degree.

> now to early stage. ... Then I know at this moment, I'm in– I belong in computing."

4.1.3 Autonomy. The ability to engage with CS on their own terms (or not), and choices that they made about how to interpret CS environments influenced participants' belonging.

Participants conceptualized belonging in terms of autonomy, in conjunction with other themes. S9 articulated a concept combining autonomy with competence, saying, "*you have to make yourself feel belong by keeping up with the class.*" T5 described how relatedness depends on autonomy, saying,

> "One, it's recognition of a community. And then number two, feeling as though you can be part of that community... and you have the choice to do that."

Genuine interest supported belonging in CS (S5, S9, T2) and motivation to study CS (S2, S3, T5, T7), whereas lack of interest could be a deterrent (T2, T6). Two participants reported contrasting experiences with Girls Who Code, free extracurricular CS programs for children in grades 3-12 (ages 9-18), affiliated with an international nonprofit dedicated to closing the gender gap in computing [22]. T6 ended up hating CS because they found it too feminized and too easy in a Girls Who Code setting, whereas S5's Girls Who Code experience made them empowered to study CS against family pressure, breaking gender-related boundaries of their parents. For S5, gaining competence in CS activated genuine interest and made them feel a sense of belonging. According to S5,

> "When I went into it, and I started learning more, I got more engaged. And then I started having a sense of belonging, because I was like, Oh, I'm interested in this, I want to do more of this."

T6 described escaping familial academic pressure to find a niche in CS. T6 described how they were interested in art, but their parents told them "*if I did any form of art, they wouldn't pay for my college. I had to do STEM*[4]." Presently, T6 did not feel a sense of belonging in CS as a discipline, but did feel belonging among a small community of artistic CS friends.

Some students described agency in their own belonging. S2, a neuroscience student, joined an interdisciplinary club combining neuroscience and machine learning (ML) as the neuroscience expert. They were the only woman, but described choosing a positive outlook to feel greater sense of belonging in the club. They saw themself proudly as among few neuroscience people who knew CS, and did not identify as a CS person, saying because they could "*barely code.*" Motivated by interest in the club's course of study, they enrolled in an ML course where they chose to accentuate the positive to increase their belonging in that class. According to S2,

> "I could perceive things very differently if I focus on the fact that I am the only female in the classroom. ... If I didn't have a positive outlook, then I probably would have just been very closed off I would have not asked questions, and I would have just felt like everyone was judging me because I was different... but I just choose not to let myself go through that path"

[4]Science, Technology, Engineering, and Mathematics

Likewise, S5 explained that choosing to engage with a group was an important component of belonging. Similarly, S9 described agency in their belonging. For example, they took the difficult action of choosing to confront a peer for saying something insensitive, and improved relationship with the peer. They also articulated that it was a student's own responsibility to keep up with class material in order to belong.

4.1.4 Basic Needs. Another component was basic needs. T3 raised safety as a component of belonging, saying belonging is when "*you feel comfortable where you are.*" Lack of resources could impede belonging, for example "*you don't have a good computer, and you probably have to write everything down*" (S4). We present examples of the need for safety in conjunction with competence in section 4.1.1. As an example of need for resources, S4 reported that learning about opportunities in CS was important towards belonging in CS. S4 described themself as low-income and Latinx, and explained that their parents, immigrants from Mexico, strongly encouraged and supported their decision to go to college, but had only a fifth grade education. S4 described learning about college and engineering in middle school and high school (ages 12-18) programs, saying,

> "That's how I knew that I wanted to do mechanical engineering and eventually got into the world of CS. Participating in these programs provides access to people who can't afford it and don't even know these places exist in the first place."

4.2 TA Actions

Students and TAs articulated TA actions addressing the needs for safety, competence, relatedness, and autonomy described above, in terms of both specific TA actions in the office hour interaction that the researcher had observed, and other office hour interactions, real and hypothetical. This section presents student and TA descriptions of office hour interactions, TA strategies and their rationale, and participant ideas of hypothetical TA actions relating to each theme. Note: TA actions addressing safety were also associated with relatedness or competence, and are described in sections 4.2.2 and 4.2.1 below.

4.2.1 Competence. Participants described how TAs supported student competence by fostering understanding of the material, a central component of the TA's office hour role.

Giving the student sufficient time was essential to support student understanding. Not only did participants share that it took time for a student to comprehend material (S3, T5, T7, S9), but also that a TA's patience showed care and made students feel valued (S5, S9).

According to participants, TAs worked to learn student context with the specific problem they were working on, which supported student competence and also respected student autonomy by helping students learn on their own terms (S3, S6, T3, T7). T6 described the strategy of asking students to explain their reasoning, which also supported student autonomy by engaging on the student's own terms. TAs described varying levels of prior knowledge that a student might have, and how TA assumptions about student knowledge could impact belonging (T2, T4, T7). For example, in an intermediate CS majors course, T4 described the strategy of "*not*

assuming prior knowledge," because "*if you assume that they know it, and they don't, it can feel embarrassing.*" In contrast, T2, in an advanced non-majors course with few prerequisites, described a strategy to "*assume a base level of knowledge and then you tailor it back,*" to avoid being condescending about basic knowledge that students do know.

Participants indicated that it was important for TAs to explain concepts to support student understanding rather than giving away answers. Some participants reported having TAs give away answers or partial answers was tempting (T2), easy (T9), or wished for (S9). However, participants underscored the importance for students to understand concepts or process underlying the answer (S2, T3, T9) and to have an active part in figuring it out (T2, T6, T7), and some connected understanding to belonging (T3, S9). A reflection by S9 connects this to the autonomy theme of owning one's growth: "*If they just give you the answer, you will never learn. ... It's all about, like, making your growth yours.*"

TAs had different perspectives on why not to give away answers. T7, who had been a TA for one year in high school (ages 14-18), was a 2nd term TA at university, and had attended about half the CS department TA training. Their reasoning was based on student autonomy in learning:

> "If I guide them through everything and saying, let them to find out their own solution and mistake... they are making tons of contribution to their own work."

T2 was a 3rd term university TA and did not participate in TA training. Their reasoning was based on performance in a competitive environment:

> "it's kind of unfair if... this one student gets confirmation that this yes, is completely correct and the other 99 students or whatever in the class don't."

Though T2's own reasoning was based on performance, they also reported internalizing a fellow staff member's autonomy-based reasoning similar to T7's perspective.

In support of student understanding, some TAs described the importance of encouraging students to look things up (T4, T7, T9). However, students asserted that TAs should be better than online references (S9) and that referring to reference materials could be seen as a challenge to the student's preparedness or as reluctance to directly help the student understand (S4).

For S7, speaking to the TA in their shared first language was key to understanding. "*T7 can speak Chinese. So our conversation is more efficient. ... I can like describe my question more clearly.*" This connects with T7's past experience learning that their own TA was a Chinese speaker:

> "Because I feel like naturally I feel like more belonging and they can help me more ... I have more confidence in Chinese studying mathematics"

4.2.2 Relatedness. As described above, barriers toward fulfillment of relatedness needs included lack of safety, lack of community, and negative comparisons to peers. TA actions responded to relatedness needs by addressing each of these.

Students reported feeling safer as result of TA validation. Students indicated that having a TA lift them up promoted belonging (S3, S5, S9). T9 reflected on validation, saying,

> "I think the main thing with S9 is trying to make S9 feel like the questions that S9 is asking are okay, and that they're not too basic. ... I think your tone and the way you respond to somebody's questions are important."

T9's outlook on answering basic questions connected to their experience asking basic questions upon entering a CS Master's program with a humanities background. S9 found T9's validation to be helpful in that

> "T9 praised me on saying like, oh, like I actually asked really, like, deep questions, ... I feel like oh, wow. Like, my question is being valued, like my time is being valued."

When S5 was blaming themself for a problem with their code, a little validation from T5 went a long way:

> "T5 understood, like, right away. And T5 was like, Oh, this is like, totally fine. ... Thank god T5 understood. Because I was not feeling great. I was like, what is wrong with me?"

T5 reported familiarity with the danger of blaming students for language-related problems like S5's, saying,

> "There's a slight tendency sometimes to sort of fault the student for not, keeping up with the language of the classroom. ... I just want to make sure like, students aren't faulted for that. ... It's a common experience. And all it means is you just have to be careful about Unicode."

Another way of fulfilling the student need for safety was by students and TAs mutually building trusting relationships A TA could become familiar with a student's learning needs and build a relationship with the student over several office hour sessions (T2, T9), or based on knowing them from recitation section (T2) or previous course (T3). S9 and T9 described getting to know each other. T9 says,

> "I know S9 pretty well. ... S9 was one of those students who comes to every almost every office hour. ... S9 has even, like, sent me some emails, or at least an email before, basically thanking me for like, encouraging S9."

S9 describes coming to trust T9, saying,

> "I went to T9's very first office hour... I've established a relationship early on. So then there was this trust. ... I can be safe because I know I'm not being judged."

Participants indicated that to forge connections with students, it could help if the TA was warm, sociable, and shared personal experiences (S2, S6, S9, T4, T5). In S2's words,

> "TAs are not perfect either, you know they're also dealing with a lot of stress and just kind of knowing that that aspect of vulnerability just makes me feel more connected to them as a human being."

Both TAs and students indicated showing care supported student belonging (S2, S6, T7) Students described how TAs could show care by preparing and bringing their energy and engagement (S2, S6, S7, S9), and by using students' names (S2, S6, T7). According to S6,

> "Knowing people's names and using the name... it's a really great way to get people to feel a part of and heard and seen. ... People feel like you care."

They also reported it was helpful for TAs to show appropriate emotions. Not showing emotion or displaying annoyance, a bad mood, or coldness could harm student belonging (S2, S6, S9, T7), while warmth and a visible affect could help with student belonging (S2, S6, S9).

For S5, care in the form of T5's greeting brought relief from overwhelming nervousness about office hours. T5 described it as professionalism, saying,

> "I say, 'Hi, this is T5, from [CS2 for data science]. ... come to my Zoom[5] meeting, let me help you.' I think just at the bare minimum, it's just instructors, being polite to their students."

This simple act of introduction had a profound impact because it helped alleviate S5's anxiety. From S5's perspective,

> "Then I get help through the TA and you know, and then they greet me. And then I felt a little bit like, relieved. I was like, ha, yeah. I'm good."

One way TAs supported the student need for community, and through it their belonging, was by connecting with students. Participants inclined to connect with their TAs reported these connections could improve belonging, within limitations of professional distance between students and TAs. T5 reported such an experience with TA-led extra credit seminars and study sessions, saying

> "I did not recognize a single person who just came regularly to any of these except for the TA that was running the show. And so in a way, it just made me feel more connected to the people who are running the show. ... The flip side of that is, the recognition of the TA community was something that I couldn't be part of anyways, because I was a student at the time, and they were TAs."

T7, who had connected with their own TAs and instructors, shared that they enjoyed forming connections with students but maintained professional distance by setting boundaries,

> "So these are the ways I feel like belonging is high. And like when students realize you actually care for them. And they would love to like be friends with them even just asking me hey, T7, how's your weekend? Or like, follow me on Instagram or ask me out for dinner? I mean, that's kind of across the boundaries there. But I'm really happy even if I have to turn off their offer."

TAs also supported community formation by helping students meet peers. T3 described that they turned a corner in a difficult class after forming a study group with peers met in office hours, and afterward began to encourage their own students to collaborate. In T3's own words,

> "They're stuck on the same problem I'll just ask them, alright while I teach the other student, you guys can discuss and I'll come back to you in several minutes when I'm done."

[5]Zoom is a video call platform.

S7 shared that TA encouragement could be just what was needed to talk to peers, and expressed willingness to give up some autonomy for it. In S7's words,

> "Maybe like, force the student to get together to have conversations. ... I am not the... outgoing person that can speak to someone like near me. But if my TA would ask... I might feel willing to to talk with some other people. ... It will be weird, but for me is a suitable strategy."

S7 described an experience where complying with an icebreaker activity led to meeting peers who S7 then recognized in a different class the next academic term.

By getting to know peers, participants experienced greater academic success. Participants described that having friends could contribute to belonging by contributing to academic success (S4, S9, T7). For example, S4, whose CS1 study group formed from members of the Society of Hispanic Professional Engineers, said, "*I feel like I always do better when I work with people*," and S9 shared feeling encouraged not to skip class because of feeling missed by a friend in that class. T3 described how study groups improved their performance,

> "I started going to office hours and I started finding friends who were in the same position as me... weren't sure about how to approach each assignment then we will talk about it and work together and from a study group. And that made me from almost failing [probability and statistics] to getting a solid grade. ... Since that point I guess you can say that I have found my sense of belonging in CS."

TAs could help counter student tendencies toward negative, self-deprecating comparisons to peers by telling positive narratives about peers. S9 indicated it was helpful to receive advice on reframing negative comparisons. S9 described at first feeling intimidated when peers asked advanced questions, but the instructor offered another framing. In S9's words,

> "We cannot discount the amount of effort it took them to get here... everyone was once a beginner. Yeah. So then that kind of puts perspective into this. So that helps me feel better. ... He has grinded really hard to get to that point. And he deserves to ask that question. And that has nothing to do with my worth."

Participants described how TAs could offer reassurance to indicate the student was not alone because their struggle was shared by other students, the TA, or computer scientists in general (S3, S5, T4, T5, T7, T9). According to T9,

> "These issues that S9 was struggling with in this assignment, are actually things that real computer scientists, like I guess, myself also struggle with. ... You're dealing with the same problems as someone who belongs."

In contrast with negative self talk that students may be experiencing, they indicated positive narratives about one's peers could help to build feelings of commonality and belonging (S6, T3, T4, T5, T9). As T5 explained responding to a student's bug,

> "Just the acknowledgement of like, using different languages and different keyboards and stuff, being like, hey, I have a common experience with you. And this is something that a lot of other students have as well, even if you don't see it."

4.2.3 Autonomy. TAs supported student autonomy in office hours by explaining concepts to support student understanding and guiding students to discover answers, rather than giving away answers. Examples where TAs knew answers but did not give them away illustrate interplay between competence and autonomy in section 4.2.1. Furthermore, S9 and T9 shared an office hour in an advanced course. T9 described how there were many ways to solve the homework problem and T9 didn't ultimately get S9 to a solution; in the end, S9 was responsible for figuring it out. In T9's words,

> "I remember even being a little confused about what was happening in S9's code. ... But later, like S9 went away and figured out what S9 needed to do to make this work. I don't want to say it was based on the advice that I gave S9. It was probably mostly like S9's own experimentation."

From S9's perspective,

> "Once I kind of have a sense of what T9 is teaching me, I went back to solve the problem and it ended up me and [my friend in the course] figured out the solution."

Another way TAs supported student autonomy was by engaging on the student's own terms. T6 described getting the student's reasoning with,

> "Ask them questions, instead of talking. ... If you can get a student to explain the reasoning, you can figure out why they're confused. ... I think also gives students a chance to feel like their voices are heard."

An awareness of student autonomy connects to T6's experience of restricted autonomy, navigating family pressures to chart their academic course of study. T4 described letting students drive the interaction, a skill that they were working to improve, saying,

> "There were times when I found myself talking over S4 and then caught myself and stopped. ... I'm trying to do it less in office hours and sit in the silence and let them bring up questions."

S3 reported an increase in belonging when T3 engaged on S3's own terms, specifically,

> "T3 was really great, it's just asking, what's the problem? How do I do it, and reasoned through with what I was doing, acknowledging what I was doing wrong, and how I could fix it."

5 DISCUSSION

When we asked students and TAs about their concepts of belonging (RQ1), their stories, taken in aggregate, described satisfaction of the three psychological needs described in Self-Determination Theory: relatedness, competence, and autonomy. Some also surfaced the needs for safety and access as key components of belonging. TAs and students reported that TAs supported these needs by fostering understanding of the material, treating them with empathy, helping them to see peers positively, and helping them to own their own success (RQ2, RQ3).

We believe our results are applicable outside the Allen School. To predict applicability to different contexts, the context of our study matters, including that UW is a large R1 research university where a plurality of students are white, and that the Allen School has large classes with many undergraduate TAs.

Some aspects of our study design limited the results. For example, this work did not systematically explore negative patterns of TA behavior around belonging. Recruiting pitches were designed to appeal on the basis of interest in inclusive practices, so it's likely our results represent participants with more clearly thought out ideas about belonging, including TAs more active in promoting belonging than average. As possibly an indicator of this, all participating TAs except one saw it as their responsibility to help students feel belonging. Furthermore, the paired nature of study participation, described to prospective participants from the start, means paired TAs and students were not anonymous to each other, despite careful protection of privacy outside pairs. This might have inhibited them from saying critical things about their counterpart. The study occurred in summer term, with smaller classes and less experienced lead instructors. However, curriculum and duration of term were the same as during the academic year and all returning TAs in the study had taught outside summer term. Furthermore, interview conversations encompassed participants' journeys of belonging beyond the bounds of the present academic term. Our sample was weighted towards final-year students, perhaps because of the summer term, or perhaps because of typical enrollment of courses we recruited from. Though researcher presence in office hours might have changed behavior of those observed, the first author mitigated this through non-invasive presence, described in section 3, and we used observed office hour interactions to recruit interviewees, not as data for analysis.

Even accounting for these limitations, our work is broadly consistent with the psychological needs described in SDT as necessary for psychological wellbeing and autonomous motivation [16]. At university, belonging in a discipline could be construed as seeing it as a befitting course of study, which aligns with being motivated to study it. By this interpretation, our evidence suggests that in our context, belonging was more synonymous with motivation than with relatedness, even though SDT categorizes belonging as part of relatedness [16].

This might not be the case had we limited ourselves to a definition of belonging only encompassing relatedness, e.g. Josselson's 8 dimensions [29]. However, competence appears as a component of belonging in CS education [60]. Since an academic environment centers on students building their knowledge, and since a defensive climate, in which students form social hierarchies based on knowledge, is prominent in CS [6], competence could be understood as a context-specific example of the more general idea of "fit" with the environment and with others. Or, since many environments where one might belong focus on knowledge, it is possible that competence should be elevated as a component of belonging in its own right in trans-disciplinary definitions of belonging, such as Mahar's review of belonging [36].

Bringing in a structural framework, we can surpass the individual and interpersonal scope of human needs theories and understand the results of this study as exposing need for structural change. Rankin et al. discuss how systems of oppression, such as exclusion of Black women from computing, play out through interpersonal interactions, for example, an instructor answering a question in a way that makes a Black woman student feel stupid [48]. In CS, those who feel they belong choose to continue, normalizing the culture that filtered for them in the first place. Without structural intervention, such discriminatory cycles will continue [61]. TAs in our study said it was their personal responsibility to promote belonging but not their job description. This suggests that the Allen School lacks effective structural policies to steer interpersonal interactions toward inclusion, and that the TAs in the study were acting individually. In this interpretation, our work exposes a need for structural change in the Allen School so that our study TAs' personal outlooks on belonging can be enshrined more broadly and permanently.

Our work suggests that individual TAs can support community formation, offer appropriate help with course work, and show kindness through validation to support student belonging. TAs might contribute to community formation by helping students meet each other and by being a friend to students, within professional boundaries. This aligns with prior work indicating university peers can be a source of academic and social support, leading to belonging in CS [60]. In light of the fact that peer relationships are extra important for Black women [52] and that peers may exclude Black women from study groups [48], TAs might be especially attentive to inclusion of Black women and others from minoritized groups as they help build community. Our results show nuance in guiding students through course work without giving away solutions or withholding information, and suggest TAs should take into account the course level and individual student needs to determine how much to give answers versus guidance. According to our data, when TAs respond with care, use names, lift students up, validate, and reassure, it can increase feelings of belonging, in alignment with hiring criteria expressed in [35], stating that TAs should be "empathetic toward struggling students." This suggests that kindness, not only academic support, is vital in TA behavior toward students.

Based on a structural interpretation of our results, it is important not only for TAs to behave individually in ways that promote belonging, but also for instructors and administrators to make structural change to promote belonging. Both approaches apply to the phenomenon of negative comparisons to peers, observed in our data. Our results show that negative comparisons to peers, especially when based on exaggerated or imagined characteristics, can harm belonging. To address this phenomenon as imposter syndrome, TAs can support individuals experiencing it by mentoring them, helping them gain awareness of it, and pointing out they are not alone [47]. Or, to address this phenomenon as competitiveness of defensive climate, TAs might reign in experienced students' performances of academic prowess, value wrong answers as useful, and encourage students to see each other as collaborators, toward shifting the larger classroom climate [7]. Beyond the classroom, administrative structures can shape climate. For example, in the Allen School, judgment and competition imposed by administrators gatekeeping acceptance into the CS major set an example for students to view their peers competitively and judgmentally. By this interpretation, our results suggest a less competitive admissions system, such as lottery-based admissions [43], might reduce negative peer comparisons and help students feel a greater sense of belonging.

To expand and perpetuate TA action that supports belonging, it is critical for instructors and administrators to hire and train TAs accordingly. We challenge coalitions of TAs, faculty, CS department chairs, and policy makers to address these questions:

- Are TAs systematically trained about the importance of understanding each student's context to foster understanding and help individual students build CS competence?
- Are TAs hired based on social and emotional skills and trained in these skills to empathize and validate the struggles of students with widely varying personal and academic backgrounds?
- Are TAs hired based on their cultural assets that qualify them to support students who share those assets, such as first generation status and first language? Are diverse cohorts of TAs hired to leverage each unique TA's cultural assets toward effectively teaching and mentoring diverse groups of students?

As a start, we encourage instructors and academic leaders to implement TA trainings that address identity and belonging [42]. We hope addressing these questions will be one step in a trend towards university CS programs placing a greater emphasis on promoting student sense of belonging, both through TA training and more broadly, so that all CS students can truly feel like they belong.

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