Breaking "Finish-in-Four Stigma":

How Community College Transfer Women Make Meaning of Their Degree Trajectories and Computer Science Identity

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Abstract

This paper explores how community college transfer women make meaning of their computer science (CS) identity and degree trajectories. Drawing on theories of STEM transfer pathways and disciplinary science identity and relying on interview data from community college transfer women majoring in CS, I classified the majority of community college transfer women into one of two groups that characterized how they navigated their degree pathways: (1) *efficient linear strategizers* prioritized degree efficiency with a goal of graduating in about two years after transferring, and (2) *pathway adapters* described changing values and goals that led them to significantly adjust their degree timelines. These distinct pathways relate to how students identify with CS and point to opportunities to humanize women's transfer experiences and rethink degree efficiency as a unilateral priority.

Keywords: community college transfer; feminist standpoint theory; computer science

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Meaning of Their Degree Trajectories and Computer Science Identity

Computer science (CS) degrees provide opportunities for upward social mobility via lucrative tech careers (Bureau of Labor Statistics, 2016). Because of the power and financial reward afforded by CS degrees, it is concerning that women represent only about 20% of CS bachelor's degree recipients (NCES, 2021). Women's underrepresentation and participation in CS degree programs has received significant research attention (Sax et al., 2017), with studies revealing the importance of fostering women's early identification with CS (e.g., Clarke et al., 2023; DuBow et al., 2017). Unfortunately, women who begin their degrees at community colleges are often excluded from this research, despite the role community colleges play in facilitating access to higher education (LaSota & Zumeta, 2016). Indeed, computing majors who start their degrees at community colleges (i.e., upward transfers) are more racially, ethnically, and socioeconomically diverse than computing majors who enter their universities directly from high school, but most studies on women's participation in computing have focused on students who follow direct pathways from high school to universities (Blaney, 2020).

While more research is needed on how upward transfer women navigate their CS degree trajectories, broader studies of transfer pathways across fields document persistent inequities in how students navigate transfer trajectories, both before and after transferring (Hartman, 2022). Across STEM disciplines, relative to men, women more frequently leave their STEM major after transferring (Zhang, 2022) and report higher levels of transfer stigma at their universities (Blaney et al., 2024), which may threaten their disciplinary science identity (Rodriguez et al., 2024) and contribute to their attrition from STEM (see Perez et al., 2013). Thus, it will be important for future research to specifically consider the university experiences of STEM transfer students.

This study merges theories of STEM upward transfer (Wang, 2020) and disciplinary science identity (Carlone & Johnson, 2007) to explore how women in CS make sense of their identities as computer scientists and navigate their degree trajectories *after* they transfer from community colleges. Engaging feminist standpoint theory (Harding, 2004) and a general qualitative design (Percy et al., 2015; Saldana, 2016), I used interview data from 12 upward transfer women in CS majors to address the following research question: *How do upward transfer women in CS describe and make meaning of their identity as computer scientists, and how does their CS identity relate to the decisions upward transfer women make about their degree trajectories?*

Background

This study is contextualized within literature on women's participation in computing and guided by feminist standpoint theory (Harding, 2004), science identity theory (Carlone & Johnson, 2007), and Wang's (2020) work on STEM transfer trajectories. Below, I briefly review guiding literature before discussing the theories that inform the present study.

Summary of Guiding Literature

Foundational research on women's participation in computing identifies how the discipline has been constructed in unnecessarily masculine ways that exclude women and pervade all levels of education (Margolis & Fisher, 2002; Sax et al., 2017). Especially relevant to this work, computing identity has been explored as a predictor of women's retention and persistence in undergraduate CS majors (Clarke et al., 2023), and researchers argue that we must understand CS identity development as part of efforts to advance equity by creating conditions in which students can equitably develop their identification with CS (Rodriguez & Lehman, 2017).

Thus, CS identity has emerged as a major focus within the large body of literature examining women's computing participation (Sax et al., 2017).

While community college and transfer women have largely been excluded from studies of gender equity in CS (Blaney, 2020), scholars have increasingly recognized the role community colleges play in broadening CS participation, the diversity that transfer students bring to university computing programs (Blaney, 2020), and the unique challenges that upward transfer women may encounter in CS spaces (Blaney et al., 2024; Lyon & Denner, 2019). For example, prescribed course sequencing and gatekeeping courses often restrict access to CS degrees and may create especially harmful barriers for upward transfer women who navigate complex pathways and may be further along in their education when they decide to pursue computing (Denner et al., 2014).

Given the scarcity of studies that specifically consider upward transfer in CS, studies of transfer pathways across fields and in aggregate STEM disciplines provide additional context for this work. Such studies document the many assets that transfer students bring to their universities (Del Real Viramontes, 2021), along with challenges transfer students face adjusting to their universities (D'Amico et al., 2014). In STEM majors, for example, transfer students may disproportionately experience very high academic course loads at their universities due to course sequencing and prerequisite policies that were not developed with transfer students in mind (Elliott & Lakin, 2020). These challenges may disproportionately impact transfer students who concurrently experience gender, racial/ethnic, and other forms of discrimination (Starobin & Laanan, 2010).

Feminist Standpoint Theory

Feminist standpoint theory (Harding, 2004) provides framing for the methodological approaches used in this study. Standpoint theory asserts that maximizing "objectivity" requires the researcher to make explicit the political values informing the research, question prior knowledge produced from dominant perspectives, and develop new knowledge through feminist standpoints. Standpoint theory has been applied to understand gendered STEM environments (Parson & Ozaki, 2018) and is useful for critically exploring the disciplinary culture of CS that has developed around white masculine norms (Varma, 2007). In my study, I also considered how efforts to support women in CS have too often centered the standpoints of women from privileged backgrounds who follow direct pathways from high school to universities (Blaney, 2020), which informed the scope of this paper.

Disciplinary Science Identity

Providing additional framing for my inquiry, Carlone and Johnson's (2007) science identity model outlines how Women of Color identify with science, highlighting how experiences of being *recognized* as a "science person," having opportunities to *perform* scientific practices, and perceiving oneself as *competent* interact to inform science identity. Through these experiences, Women of Color can develop distinct forms of science identity, which Carlone and Johnson refer to as *research scientist*, *altruistic scientist*, and *disrupted scientist identities*. An individual with a strong "research scientist" identity may identify with their major in stereotypical ways and feel that others view them as a prototypical "science person." In contrast, students with "disrupted scientist identities" may identify with science but experience significant threats to their identity in the form of being "overlooked, neglected, or discriminated against by meaningful others within science" (p. 1202). Finally, women identifying as "altruistic scientists" may develop a science identity that does not necessarily require feeling similar to other science

students; in fact, those identifying with science in altruistic ways may view their difference from other students as a point of pride, positioning them to transform their field for good.

Recent studies have expanded upon Carlone and Johnson's (2007) work to focus on specific STEM disciplines. Most relevant to the present study, scholars have considered CS identity development, defined as the process by which "students understand, negotiate, and are recognized for their role within the computing field" (Rodriguez & Lehman, 2017, p. 231). Such constructions of CS identity have been used to understand retention and aspirations in one's field (Mahadeo & Hazari, 2020; Taheri, 2019), drawing on national survey data. For instance, Taheri (2019) identified how being recognized as a science person positively predicted persistence in computing, while Mahadeo and Hazari (2020) found that performance, competence, and recognition positively predicted computing career plans. These findings guided my focus on how CS identity may relate to transfer women's CS degree pathways.

STEM Transfer Momentum

Finally, because I was interested in exploring CS identity in relation to upward transfer women's degree trajectories, I look to Wang's (2020) work on STEM transfer momentum. Wang (2020) identifies four distinct "momentum trajectories" that students follow as they work toward transferring (i.e., *linear upward*, *detoured*, *deferred*, and *taking a break*). These trajectories provide insight into stratification, as students who occupy the highest levels of privilege tend to follow linear upward trajectories, in which they make linear forward progress and transfer to universities without significant delay. In contrast, other students take detours, such as attending multiple institutions or changing program paths. Still, others defer their transfer aspirations, by completing a community college credential and entering the workforce, or take a break from school without earning a credential due to numerous obstacles in their transfer journeys. In this

study, I expand upon Wang's work to explore university experiences among students after they successfully transfer.

Application and Synthesis of Theories

Feminist standpoint theory (Harding, 2004) guided my qualitative approach to this work. Notably, standpoint theory informed my decision to center upward transfer women, as opposed to drawing comparisons to men and/or non-transfer students. Additionally, because transfer students disproportionately come from racially minoritized groups in CS (Blaney, 2020), standpoint theory informed my decision to rely on Carlone and Johnson's (2007) model of STEM identity development—which they developed with and for Women of Color in STEM—in an effort to center the standpoints of transfer women who may be minoritized within CS due to both their gender and racial/ethnic identities. More specifically, Carlone and Johnson's model informed the latter stages of the qualitative analysis, including the construction of themes and interpretations. Wang's work on STEM transfer trajectories more specifically guided how I considered participants' background experiences—including the detours that many students take before transferring—and informed the interpretation of findings.

Methods

This paper draws upon a larger mixed methods study of upward transfer CS majors across five research-intensive universities in California. For this manuscript, I engaged a general qualitative research design (Percy et al., 2015; Saldana, 2016) informed by feminist standpoint theory (Harding, 2004), drawing on data from 12 upward transfer women (see Table 1) to learn about how they identify with CS and make decisions about their degree trajectories.

Data Collection

This paper includes two cohorts of CS students who entered their receiving universities in the 2021-2022 and the 2022-2023 academic years, all of whom transferred from California community colleges. I recruited participants from a larger survey sample of $N=159$ upward transfer students who completed two surveys during their first year at their receiving universities, $n=38$ of whom indicated on the survey that they identified as women. Of the women in the survey sample, I successfully recruited 12 students to participate in an interview during their second academic term at their universities, six of whom also opted to complete a follow-up interview approximately one year later.[1]

I conducted all interviews over Zoom. Each interview was approximately one hour in length and was recorded and transcribed verbatim. All participants received a $25 guaranteed gift card to incentivize participation.[2] Interview protocols were semi-structured and included questions that asked students to describe their trajectories, aspirations, and how they made meaning of their experiences over time. For example, at the beginning of the first interview, I asked students to share a word or short phrase to describe different stages of their education. Other questions asked about CS identity both indirectly (e.g., How do you typically introduce yourself when you meet someone new on campus?) and directly (i.e., Is being a computer scientist a salient part of your identity? Why or why not?). At the end of each interview, I organized my notes and reflections into a brief memo. The follow-up interview protocol included many of the same questions that students had been asked during the initial interview to solicit information on how participants' trajectories and CS identity may have changed over time, but

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[1] I invited all participants to complete a follow-up interview, but only six opted to participate. I treated follow-up interviews as extended member checks in the context of this manuscript.

[2] Students in the second cohort also received a $10 gift card as an incentive for scheduling the interview. I provided $25 gift cards upon completion of the interview for students in both cohorts.

also included questions and prompts asking for students' thoughts on emergent findings from the

baseline interviews (i.e., member check).

<div align="center">Insert Table 1 Here</div>

Data Analysis

I analyzed data thematically and in stages to address the research question, using a

general qualitative design informed by feminist standpoint theory (Harding, 2004). As the first

stage of analysis, I carefully reviewed all 12 baseline transcripts and listened to audio recordings

to identify relevant codes, which I used to construct preliminary themes that captured

participants' meaning-making related to their CS identity and degree trajectories. Consistent with

standpoint theory (Harding, 2004), this initial stage of analysis centered participants' experiences

without taking additional theories into account.

In the second stage of analysis, I reviewed the preliminary themes, corresponding codes,

and researcher memos to develop a detailed codebook. At this stage, I organized the codebook in

relation to the guiding theories to capture distinct forms of CS identity (guided by Carlone &

Johnson, 2007) and variation in how participants understood and made decisions about their

degree trajectories (informed by Wang, 2020). I also paid close attention to codes and associated

themes that related to participants' intersecting identities (particularly by gender and

race/ethnicity), informed by Carlone and Johnson's model. At this point, I conducted follow-up

interviews, which served as a member check of preliminary findings. This process of developing

themes and conducting follow-up interviews allowed me to apply feminist standpoint theory to

(1) center participant voices and meaning making, while also (2) infusing my own feminist

positionality and acknowledging the location of the work in a theoretical and sociopolitical

context.

Next, I used the codebook to individually code each baseline and follow-up interview transcript in NVivo, keeping a researcher journal to organize reflections of how my positionality informed the analysis and maintaining notes about emergent ideas and counterexamples. In the final stage of analysis, I reviewed coded data alongside my notes and drafted the findings to center participant voices and acknowledge my role as the researcher, consistent with my application of feminist standpoint theory (Harding, 2004).

Delimitations

This study focuses on upward transfer women after they transferred to one of five research-intensive universities in California. Therefore, the sample for this manuscript represents a unique group, and findings should not be used to make inferences about student experiences at community colleges or after transferring to different institution types (e.g., public comprehensive universities). Because I rely on interviews with current students, the findings provide a look at the nuanced ways in which upward transfer women make sense of themselves in relation to their CS degree programs, which may or may not align with their ultimate degree trajectories over time.

Protection of Vulnerable Populations

This manuscript uses data from a larger project that received IRB approval from the University of Georgia (Project ID 00009993). All participants received a detailed document that provided an overview of the research study and had an opportunity to ask questions prior to providing verbal consent to participate in the interview. I instructed participants that the interview and all questions were entirely voluntary and that they could revoke their consent at any time. All participants provided a pseudonym, which I used to protect their confidentiality during the interview and in resultant publications. I also took care to obscure participant

identities in this manuscript by withholding details about participants that could be used to identify them.

Author Positionality

I bring a feminist lens to this study and recognize that my positionality shapes this research in ways that I may or may not be aware. I am a white woman with a PhD in higher education and a first-generation college graduate who did not follow a transfer pathway. While I am a disciplinary outsider to CS, I have been studying equity in computing for 10 years. A guiding principle I bring to my work is a desire to nuance how we approach the study of equity in CS through methods that humanize students. My feminist orientation leads me to ask questions about who is (de)centered within studies of equity in CS, guiding my focus on community college transfer. I reflected on my positionality throughout the research process, including the early conception of this manuscript, all stages of the analysis, and as part of interpreting the findings.

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Findings

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My research question asked about how upward transfer women identify with CS and how their CS identity relates to their understanding and decision-making regarding their degree trajectories through CS. In the findings that follow, I present themes capturing CS identity (Part I) and degree trajectories (Part II), before briefly synthesizing how findings address the research question.

Part I. Multiple Ways of Identifying with CS

To understand how upward transfer women identify with CS, I constructed three themes, which roughly align with Carlone and Johnson's (2007) forms of science identity, capturing altruistic, disrupted, and prototypical CS identities. While participants tended to adopt one of

these identities as the primary way that they related to CS, the themes were not mutually

exclusive. As I present these findings, I discuss how themes emerged and co-occurred across

participants and draw connections to Carlone and Johnson's model by noting how participants

developed their identity through experiences related to CS recognition, performance, and

competence. Table 1 also includes brief references to participants' dominant and multiple CS

identity/ies.

Adopting an Altruistic CS Identity: Valuing Difference and Being a Role Model

Nearly all participants described aspects of an altruistic CS identity, in which they placed

high value on their current and/or potential contributions to CS, aspired to be role models in CS,

and identified with the unique perspectives they bring to the field, which were sometimes

directly tied to their transfer experiences. For four participants in particular—Amelie, Ariel,

Kate, and Shay— a desire to transform the field by breaking stereotypes about who can be a

computer scientist and being a role model for other women and girls was a central and highly

salient part of their identity. Sometimes, this took the form of being proud to be different than a

"typical CS student." For example, Amelie—an international student from China with college-

educated parents—described a strong CS identity and desire to break stereotypes:

> People always stereotype [CS] students—that they prefer to spend more time studying
>
> instead of going out, maybe they are a nerd—I like to, I'll say, just break the stereotype,
>
> because people can see that I'm really outgoing.

For Amelie and other upward transfer women, there was an expressed sense of pride in "not

fitting in" or "not [being] exactly like" other CS students. Still, participants were able to

recognize themselves as computer scientists and appreciate the dissonance of both not fitting in

with others in CS and viewing CS as a salient part of their identity. While this was a common

refrain among participants, this dissonance is particularly well illustrated by comments from

Kate, a white woman with college-educated parents who had taken extended time away from

school before returning to college to pursue CS:

> I'm not that concerned about fitting in… I think that I have a right to be here just as much
>
> as everyone else. I've earned my spot… I keep mentioning being older, but that's
>
> something that does come up. Like, if I was…a 20-year-old woman, there would
>
> probably be a lot more of that gender stuff and insecurities…but now, I think I don't fit
>
> the mold of the typical [CS student]. But I think that's good.

As a transfer student who had previously taken time away from college to care for an ill family

member, Kate described how she is sometimes self-conscious of her age but ultimately did not

feel that she needed *recognition* from her classmates in order to view herself as a computer

scientist. Kate further expressed pride in her ability to support her CS classmates, in part, by role

modeling her "life perspective" and "resilience."

In other instances, participants described feminist values more directly. For example,

Shay, an international student with college-educated parents, discussed how she chooses to speak

up when she observes discrimination in her CS courses:

> When I see male students, like…in one of my classes, there was this girl asking the
>
> professor something, and then there was this guy giving *his opinion on her opinion*… I
>
> keep thinking like, "you don't get to do that. Like, what in your lifetime and in this
>
> society made you think that is okay?" And I will jump in. If it's not appropriate, I don't
>
> care. I will jump in, and I will correct someone, even if I don't know the girl or
>
> anything…those things are important to me… With me being Persian, with me being a
>
> woman, that does tie into that passion of mine as well.

Shay described a CS identity that was rooted in feminism and tied to her other identities as a Persian woman who followed what she would describe as a unique pathway as an international transfer student. By intentionally reflecting on her position within CS and her other identities and experiences, Shay navigated CS in a purposeful way that contributed to her strong, altruistic CS identity.

Similarly, Ariel described how her multiple and intersecting identities—as a woman, Latina, and first-generation college student—motivated her to be a role model in CS. Ariel further discussed how her CS identity/ies evolved over time:

> For so long, I tried to conceal who I am, tried to blend in any way that I could, not stand out, like really minimize those differences. And now I just feel like companies want people like me. Like, people want to know this different perspective. And I feel like the background that I came from, you know, I came from like, low socioeconomic status, single parent. I had all this stigma that I just kind of held in my head…I don't even know where I got those ideas from… It just feels like my identity—of being a woman and being Hispanic, all these different things—I see them as part of the positives now.

Ariel also described challenges and discriminatory experiences that threatened her CS identity, especially earlier in her studies and while adjusting to her university, but went onto explain how these experiences motivated her "to be that role model" in CS and to "show that we're out there," referring to her identities as a Latina computer scientist. Like Shay and others, Ariel was driven by a desire to improve the field, especially for other Women of Color, and the community she built at her university facilitated her altruistic CS identity. Notably, Ariel received *recognition* within the transfer center where she worked and gained opportunities to *perform* her CS skills as a tutor to other transfer students, which supported her CS identity development. Through these

interactions with other STEM transfer students, Ariel received the support she needed to develop

a strong CS identity.

Navigating CS Identity Disruptions: Feeling Like an Outsider

While nearly all participants described some degree of identity conflicts in CS, half of the

participants described their dominant experience in CS as "feeling like an outsider." In some

cases, participants described a general sense that they do not belong in CS and have thus chosen

to develop an identity based on their other interests. This was the case for Em, a Latina student

with college-educated parents who was homeschooled in a rural area before she began taking

community college courses and eventually transferring. Em identified as being "very outgoing"

and expressed concern that she did not fit in, because she is not "obsessed enough with CS."

Further, Em did not *recognize* herself as a CS person, going on to explain that CS "is definitely

not an important part of [her] identity" and that she does "not really associate it with [herself] too

much." Accepting that she was never going to identify with CS made space for her to prioritize

other interests, while still pursuing the CS major. While this was not necessarily a negative

experience for Em, her lack of a CS identity informed how she spent her time, opting to build

friendships primarily with students in other majors, likely limiting her opportunities to develop a

CS identity through *performing* and receiving *recognition* within CS spaces.

Other times, students drew harsher comparisons between themselves and other CS

students who began their degrees at the university, which led them to adopt a fractured sense of

their CS identity. For example, Ann—an international student with college-educated parents—

questioned her *competence* in CS when she compared herself to her classmates who had not

transferred.

> I do feel some difference as a transfer student… In some of the upper division courses
>
> that I'm taking right now, some of the students are in their sophomore year. I feel some
>
> difficulties in there as a junior, and those students are still in their sophomore year, so I
>
> think, "why are they smarter?"

Throughout the interview, Ann was hyper-critical of her abilities, comparing her academic

performance during an especially difficult time—her first quarter at her university, during which

she was enrolled in a very high course load—to that of her non-transfer peers who she perceived

as being more successful than her, with relatively less effort.

Other times, students discussed identity threats in relation to non-academic comparisons

or a more general sense of being stigmatized for being an older transfer student. For instance,

Gray, a white woman with college-educated parents, described a generational divide that made

her feel isolated:

> I feel a little lost. I'm an older student. I just turned 26, and I'm surrounded by 18- [and]
>
> 19-year-olds, so I don't really have people to hang out with, because just my maturity
>
> level is just so far beyond many of these people… It's very hard to find a group,
>
> especially when they've all been in their own groups since freshman year… Socially, I
>
> feel like I don't fit in at all. I just feel like a complete outcast.

Gray's experience was unique from that of other participants in that she went onto explain how

the generational divide she felt as a transfer student led her to socially isolate herself and

withdraw from student organizations, so that she could focus on completing her degree and

graduating. Notably, Gray espoused racist and other discriminatory views at different points in

the interview when discussing what she perceived as hostility from her peers for being "a

millennial white woman," referring both directly to her interactions with Asian students and

other Students of Color, as well as using coded language that referenced "from-the-Bay-type groups" or "Gen Z" students. I leaned on my feminist approach to make sense of Gray's experience and situate this finding in relation to structural racism that too often characterizes CS spaces (Yadav & Heath, 2022). While Gray provides a unique example that does not represent how and why other participants withdrew from peer interactions, this example begins to illustrate how CS identity and degree trajectories were closely tied, as Gray's isolation from other CS students led her to prioritize completing her degree "as soon as possible." That is, feeling like an outsider within her major motivated Gray to finish her degree quickly, prioritizing her degree timeline over engagement on campus.

Importantly, other participants felt isolated within CS student spaces in different ways. Maya—an Asian commuter student with college-educated parents who described feeling isolated as one of the only women in her CS courses—explained that she sometimes questions her *competence* in CS, even within spaces for women in computing, as she perceives that the women in CS groups "have things more figured out" than she does, because most of them had not followed a transfer pathway. Overall, these findings suggest that experiencing isolation concurrently within CS courses *and* within identity-based computing groups led to especially challenging identify conflicts. Isolation within courses made it difficult to develop a CS identity within the dominant group, while isolation within identity-based groups made it difficult to develop an altruistic CS identity within counter-spaces.

Identifying as a Prototypical CS Person

While most students described either a dominant altruistic or disrupted CS identity, two participants expressed a CS identity connected to their identification with particular personality traits and interests, which they perceived as prototypically associated with CS. For example,

Bea—a Black woman and first-generation college student who described herself as "a huge nerd"—explained how she enjoyed spending many hours behind a computer. Because of her interests in Comic Con, video games, and computer graphics, Bea was able to *perform* her CS expertise, develop her sense of *competence* in CS, and begin to *recognize* herself as a prototypical computer scientist. When I asked about her interactions with other CS students, Bea responded, "I like to make fun little tools for like 3D graphics… I typically like to talk about that a lot." Importantly, at other points in the interview, Bea also described instances of discrimination from peers, especially as the only Black woman in her CS courses. For Bea, leaning into what she perceived to be her stereotypical CS interests provided opportunities for her to connect with (mostly white men) peers. Here, my feminist approach to the analysis led me to question whether the fact that Bea did not discuss identifying as a role model or connecting with other women in her major might speak to the limited models available for college women to disrupt the dominant culture of CS. Because existing interventions to support women in CS tend to center white women and white feminist perspectives (Birhane & Guest, 2020), it is possible that Bea did not have equitable opportunities to engage with other women in CS due to anti-Black racism within those spaces and her (arguably) stereotypical interests.

It is also important to note that some participants who identified strongly with CS stereotypes also had altruistic CS values. For example, Rose, an Asian and first-generation student—described her intellectual curiosity and motivation to use CS to address climate change:

I like researching new, never-before-seen methods… Just like pushing the frontier, pushing the borders of environmentalism through computer science. Because not many people have that career goal in mind… I'm in a research mentorship program right now,

and it's helping me figure out which specialization is best for me…to help mitigate the

effects of climate change through computer science.

Throughout the interview, Rose described how she developed her CS identity through her love of

research, desire to use CS to address climate change, and experiences in groups for women in

computing. For Rose, being a "CS person" was central to her identity; at the same time, altruistic

motivations and a desire to build community for women in computing informed her sense of

belonging. This is representative of the larger ways in which upward transfer women's CS

identity development was complex and multi-dimensional.

Part II. Typology of Values and Experiences Driving Degree Decision-Making Processes

The research question for this paper also asked about upward transfer women's decision

making about their degree trajectories. To address this, I constructed three themes that captured

distinct patterns in how students made decisions about their degrees and the values that drove

their decision making. These themes capture three distinct trajectory profiles: (1) Efficient Linear

Strategizers; (2) University Pathway Adapters; and (3) Detoured Persisters. Because students

were still enrolled in their degree programs at the time of the interview, these themes capture the

pathways that students sought out to pursue (and the values guiding those pursuits), but not

necessarily their ultimate degree paths. Unlike the themes capturing CS identities, these three

themes were mutually exclusive, and I grouped all participants based on the profile that best

characterized their experience, resulting in a typology of trajectories that builds upon Wang's

(2020) momentum trajectories among transfer-aspiring STEM students, with the present findings

pointing to additional post-transfer stratification and complexity.

Efficient Linear Strategizers: Pressure to Finish "On Time"

I classified just over half of participants into a group I am referring to as *efficient linear strategizers*. These students described linear pathways and strategic decision making to prioritize degree efficiency with a goal of graduating within two years after transferring. Students' reasons for prioritizing degree efficiency were varied. In some cases, students referred to feeling burned out, having already completed many courses and having spent years navigating transfer policies and requirements. Em—who is quoted above discussing how she does not identify with her CS peers—explained, "I feel like school has been so long, and I'm kind of ready for it to end, even though I just transferred." Em and others also spoke of a desire for financial stability that would come with graduating and entering the workforce. For example, Bea discussed how she made decisions about her degree, so that she "wouldn't have to stress about paying…rent and utilities and all that." Others referenced debt and financial aid as sources of stress, which they were trying to minimize by shortening their time to degree. It is notable that students often initially used dismissive language like "senioritis" to explain how they were "just ready to be done" with their degree. However, further discussions revealed more nuanced rationales for prioritizing efficiency, such as a need for financial stability, an aversion to accumulating more student debt, and burn out from navigating highly bureaucratic transfer processes.

While reasons for prioritizing efficiency were varied, the effects of this approach were largely consistent across participants. That is, students consistently described incredibly challenging—and sometimes untenable—course loads at their universities. As one example, Maya—quoted above discussing her feelings of being behind relative to other women in CS groups—echoed other *efficient linear strategizers* when speaking about her decision to try to graduate two years after transferring.

I'm taking four courses, and they add up to 16 units… I will have to take [this load], if I want to graduate on time. Then I have to take two summer classes too. I've also talked with other transfer students, for some people, it's just not possible to graduate in two years. They will have to spread it out to three years. That's something that did occur to me… But then it's also, like, I would love to graduate when everyone else in my class is graduating.

Maya was torn about whether she should continue with her two-year graduation timeline, contemplating during the interview if she should "spread it out to three years." Yet, Maya felt pressure to graduate with "everyone else," referring to students pursuing a four-year graduation timeline, including those who entered the university the same year she began her community college coursework. While Maya was keeping her options open, she ultimately felt motivated to complete her degree "on time," even if that meant enrolling in multiple demanding, upper division courses each term.

Prioritizing efficiency in their degree planning also required students to make sacrifices in other areas of their education. Tuen—an Asian woman, international student, and first-generation college student who described struggling with CS identity at the time of the first interview—explained how she felt pressure to enroll in a heavy course load in order to complete her degree "on time" and "catch up" to non-transfer students. For Tuen, this meant that she had little time in her schedule to engage in student organizations and social activities. When asked how she spends her time in a typical week, Tuen responded:

Honestly, it's just filled with studying. Yeah, because, it's too much. And also, I'm trying to graduate within two years. That's why I'm spending a lot of time like doing only

classes. And I don't think I have any time to manage to join some clubs or anything else.

So basically, I'm just studying all day.

Because of high course loads, Tuen and others following hyper-efficient degree pathways often

had to disengage from student organizations and make difficult choices about how to spend their

time, guided by social pressure, burnout, and larger structural constraints. As important context

for these findings, Wang (2020) notes that, while transfer-aspiring students who follow the most

linear pathways may bring unique privilege with them to their programs, their trajectories are not

without friction. My findings provide insight into the friction that these students continue to face

after they successfully matriculate into universities.

Pathway Adapters: Extending Degree Timelines

Three participants make up a group I am referring to as *pathway adapters*. These students

described how changing priorities led them to adapt and extend their degree timelines. This was

the case for Kate—quoted above describing her altruistic CS identity—who described how she

prioritized her wellbeing by discussing a hypothetical decision-making process:

It's like, I might have to take a reduced load, what does that look like? It's not all or

nothing, and I try to share that mentality… Like I said, I'm the grandma, where I see

these younger people, especially the high-achieving types, where they're just like, "I

gotta get my GPA up." I'm like, "you're gonna be okay…grades are important, obviously;

this test coming up is important, but it's not the most important thing." I think I have a

sense of perspective that just comes partially with life experience, right?

For Kate, the perspective she gained from taking time away from college prior to transfer

informed her decision-making and desire to prioritize her family and wellbeing, even if that

meant adjusting her degree timeline. Kate further described finding meaning from being able to

share that perspective with her classmates to support their personal and professional success,

consistent with her altruistic CS identity and desire to be a role model to others. Kate also

explicitly referenced the mothering or "grandma" role that she plays, which may reflect her age

and gendered socialization within the masculine culture of CS.

Similarly, Ariel discussed a myriad of reasons why she would likely extend her degree

timeline, each related to her intellectual development:

> I was actually thinking of extending my graduation date to like March 2024, which I
>
> would have been very, very mad about before. But I feel like now, I'm surrounded by so
>
> many other transfers who also have broken the "finish-in-four stigma," which is a huge,
>
> huge stigma for transfer students that I had to overcome. Now, I just feel like, well, why
>
> not… I could graduate [sooner] and take a crappy senior design project, or I can just stay
>
> for longer and do something I actually really like and am interested in… It also gives me
>
> more time to figure out, if I want to do the master's program.

As discussed in this quote and elsewhere in the interview, Ariel planned to extend her graduation

timeline by at least two terms, which would allow her to pursue a more intellectually meaningful

senior project, explore enrolling in a master's program, be more engaged on campus, and

potentially pursue a minor in math. While other students in this study described related

motivations for potentially extending their degree, Ariel stood out as being an especially

ambitious and high-achieving student who frequently took on leadership roles across campus

(e.g., serving as a transfer student mentor and tutor; being a leader in student organizations).

Even still, Ariel felt pressure to finish her degree efficiently and described what she referred to as

"finish-in-four stigma" or pressure to complete her degree in only four years (i.e., two years at

community college and two years at university). Ariel explained that she sometimes felt

stigmatized for extending her degree timeline, as though she was not meeting others'

expectations for her, which conflicted with her self-expectations to maximize her opportunities

for intellectual and professional development during college. While Ariel's situation was unique,

due in part to her extraordinarily high levels of engagement and ambition, the fact that social

pressure to graduate "on time" was so salient to her experience speaks to the magnitude of these

pressures.

Detoured Persister Pathway: Persisting through Structural Barriers

Above, I have discussed the experiences of students who exercised high levels of agency

in their pursuit of varying degree trajectories. While these students encountered myriad barriers,

they were ultimately pursuing their intended pathway. However, one student, Shay, described a

particularly challenging trajectory that differed from the other participants. My feminist approach

to this inquiry led me to examine Shay's experience closely, led me to report how structural

inequities on campus uniquely shaped her experience, and extrapolate how these findings can

inform more equitable practices in CS departments.

As context for this finding, Shay is a high-achieving student who described a strong

altruistic CS identity, grounded in her desire to help women and girls and realize her

entrepreneurial aspirations. Yet, Shay's pathway was complicated by financial hardships that

resulted in her experiencing food and housing insecurity during her transition to her new

institution. Shay explained, "I essentially did not have any money. So I didn't have money for my

courses. I didn't have money for my basic needs or anything." Because of the timing of these

financial hardships, Shay had to independently locate emergency resources at a new institution

where she had no established relationships, which ultimately enabled her persistence.

During this highly stressful time, Shay changed her major from CS to data science, a decision that she would soon regret. While Shay performed well in her programming courses, she "barely passed" her first statistics course. Because she was a new transfer student and her community college coursework did not count toward her university GPA, this single course "tanked [her] GPA." Soon after this transpired, Shay met with her advisor to change her major back to CS but learned that her GPA did not meet the requirements to gain admittance to the CS major, leaving Shay in limbo until she raised her GPA:

> I'm trying to change my major back into computer science, because I learned that I don't enjoy stats…but because I only was in this school for one quarter, the GPA is not, it doesn't exactly make sense, because I kind of messed up my stats, and it says that I have a 2.7 right now, because I only took three classes in fall… So, I have to take more classes and get more A's to be able to be eligible [to return to the CS major].

For Shay, balancing food and housing insecurity with university policies that effectively locked her out of the CS major contributed to a highly tumultuous experience. Importantly, Shay is a talented and ambitious student who described a desire to be a role model for women and girls in CS and had strong entrepreneurial aspirations that are likely to make an impact on any field she chooses to pursue. While we cannot yet know if Shay will find her way back to the CS major, the field is certainly at risk of losing her talents. In addition to creating unnecessary hardships for Shay, these barriers to her reentry into CS may lead to a significant loss for the field, should she choose to pursue a different path. This finding echoes the detours that Wang (2020) documents as transfer-intending students face structural barriers in their trajectories, with my findings underscoring how these barriers may continue *after* transfer students make their way to universities.

Synthesis of Findings

The goal of this study was to identify how upward transfer women make meaning of their CS identity in relation to their degree trajectories. I found that CS identity and degree trajectories are related in mutually reinforcing ways and are influenced by broader university structures and opportunities (Figure 1). Building on Carlone and Johnson's (2007) findings that women with altruistic science identities do "not necessarily pursue… recognition from established members of the scientific community," the present findings suggest that altruistic CS identities may position transfer women to resist pressure to complete their degrees on a prescribed timeline. That is, participants with strong, altruistic CS identities often discussed how they adapted their degree trajectory to "prioritize [their] education," wellbeing, and development. This led to opportunities for students to develop their CS identity through performance and recognition experiences that bolstered their internal sense of competence in their field (e.g., taking on leadership in a CS student group, serving as a tutor).

Other transfer students prioritized degree efficiency as a central goal. For instance, participants with prototypical CS identities were consistently on a path to complete their CS degree within two years of transfer, working to achieve success in the most traditional sense. Likewise, participants with CS identity disruptions frequently felt pressure to prove their CS competence by prioritizing degree efficiency, leading them to enroll in especially heavy courseloads. To be clear, the degree timelines that students followed were guided by much more than their CS identity, and other findings highlight structural barriers that transfer students face, which constrain their degree progress, regardless of their identification with CS. In the remainder of this paper, I further connect these findings to prior research and theory before presenting implications and conclusions.

Insert Figure 1

Discussion and Implications

The present findings expand upon prior literature on transfer pathways and disciplinary science identity to provide insight into how to best support women navigating transfer pathways in CS. I document wide variation in how upward transfer women identify with CS and make decisions about their trajectories. Echoing prior literature on science identity, participants discussed the value of gaining opportunities to perform CS, receive recognition, and develop their own sense of competence and confidence in their abilities (Carlone and Johnson, 2007; Mahedo et al., 2020). While such opportunities (e.g., serving as a tutor or mentor to other STEM students) required significant time—sometimes leading students to extend their time to degree—participants viewed these opportunities as essential to their development. This was especially the case for participants who identified with CS in altruistic ways who tended to exercise agency in charting their own path toward their degrees, resisting external pressures to complete their programs as quickly as possible. In contrast, students with largely prototypical or disrupted CS identities often described how they made degree-related decisions that prioritized graduating "on time," motivated by a "pressure to catch up" to non-transfer students. Prioritizing efficiency in this way led students to enroll in extraordinarily demanding course loads, which only further constrained their ability to develop strong CS identities. Together, findings connect science identity theory to prior work on transfer degree trajectories (Wang, 2020), highlighting the iterative relationship between CS identity and transfer pathways and illustrating how transfer student success is not necessarily synonymous with timely graduation.

Findings also provide insight into the multiple experiences and identities that shape upward transfer women's identification with CS. For Women of Color specifically, altruistic

ways of identifying with CS were often explicitly linked to participants' feminist values and

racial/ethnic identities, with participants emphasizing their desire to advance Women of Color's

participation in CS. However, gaining access to supportive spaces where students can develop

altruistic ways of identifying with CS were not available to all Women of Color in this study.

Future research and theory should consider how spaces in which women develop their CS

identity can be more inclusive of Women of Color who navigate transfer pathways (see Jain et

al., 2020; Rodriguez & Lehman, 2017). In particular, it will be important to examine how groups

for women in CS can be explicitly transfer receptive and supportive of women's multiple

identities, experiences, and interests.

Reimagining the Culture of Computing Spaces

It is notable that women in this study who expressed altruistic CS identities often

described themselves as "not fitting in" or being unlike other CS students. Understanding how

upward transfer women identify with CS and are motivated to transform the field could position

us to imagine a future where altruistic CS values are central to the field and no longer in conflict

with the dominant culture. In doing so, it will be important to recognize the diversity of upward

transfer women's CS interests, as the participants in this study had multiple and far-reaching

computing interests, including some that aligned with popular conceptions of computing

stereotypes, as was the case for participants who had prototypical CS identities. Relatedly, while

common initiatives to support women in computing have focused on creating identity-based

groups and counter-spaces designed for women in computing (Dubow et al., 2016), the women

in this study sometimes described feeling isolation within those spaces, which may relate to

research showing how initiatives for women in STEM often center white feminist beliefs

(Birhane & Guest, 2020) and the needs of women who follow direct pathways to their computing

degrees (Blaney, 2020). Centering the standpoints of upward transfer women is essential to

identifying limitations of existing approaches and reimagining inclusive spaces in CS to which

upward transfer women can bring their complete selves.

More broadly, creating a transfer receptive culture within CS departments could go a long

way in fostering CS identity among upward transfer women. Specifically, it will be important to

develop university CS environments that recognize and value the role community colleges play

in supporting CS students. It may be that students have many opportunities to develop their CS

identity at their community colleges, but that transfer stigma (Shaw et al., 2019) leads students to

place less value on such experiences. University departments should consider strategies for

increasing access to developmental opportunities throughout students' degree programs,

validating the experiences that students have prior to transfer, and removing unnecessary

administrative barriers that threaten the success of upward transfer women who are otherwise

positioned to make significant contributions to the CS field. Future research should further

explore specific strategies to build more transfer receptive university departments.

Rethinking Degree Efficiency as a Goal

Consistent with recent studies of STEM transfer pathways (Elliott & Lakin, 2020), one of

the most consistent obstacles the participants in this study faced was related to incredibly high

university course loads that required them to make difficult decisions based on competing

priorities. Some participants adjusted their course load and degree timeline expectations, while

other participants felt pressure to maintain very high course loads in an effort to graduate "on

time." To make these decisions, students weighed factors related to student debt and financial

security with their mental health, wellbeing, and professional development, typically choosing to

make compromises in at least one of these areas. Students also described pervasive university

pressures to finish their degrees efficiently, which did not always align with the personal and

professional goals participants had for themselves. While more research is needed to explore

how efficiency values are embedded within university practices, we can expect that, when

university faculty and staff place high value on degree efficiency for transfer students, the

resultant policies and practices may underserve students who do not necessarily share those

values. This interpretation is reminiscent of scholarship that has critiqued normative measures of

success, such as four-year graduation rates (e.g., Garcia, 2017). In the case of my study, feminist

standpoint theory positioned me to reveal how transfer women defined success on their own

terms.

University Support Structures and Barriers

Notably, the number of years it takes upward transfer women to complete their degrees

has important implications for student debt, and it may be that extending time to one's degree

could create financial burdens and result in further stratification. This interpretation is consistent

with Wang's (2020) exploration of transfer momentum trajectories, which reveal inequities and

stratification in how students access transfer pathways. Other research reveals that six-year

graduation rates are lower among transfer students from low-income backgrounds, relative to

those from higher-income backgrounds (Shapiro et al., 2017). Still, my findings lead me to

conclude that universities should revise student support structures to prioritize student wellbeing

first and foremost. At the same time, institutions can and should remove structural barriers that

may unnecessarily lengthen time to degree, including inflexible requirements to gain (re)entry

into the CS major and poorly conceived course sequencing. University departments can also

collaborate with community colleges to develop more holistic transfer pathways that create

opportunities for students to have balanced course loads over time that more closely resemble those of students who enter universities directly from high school.

Collectively, prior studies and the present findings point to a need for research that explores the impact of bureaucratic procedures on upward transfer students' experiences throughout their degree programs. I found that students' degree pathways were constrained by financial insecurity and bureaucratic university structures, which is reminiscent of prior research on the burdens experienced by community college students seeking financial aid (Graves, 2023). Providing housing and basic needs support during students' transition to the university is an important strategy for increasing access to developmental opportunities by removing external demands on students' time and attention. Further, minimizing bureaucratic procedures to access support services may go a long way in increasing opportunities for upward transfer women to develop their CS identity and follow their intended degree trajectories.

Concluding Thoughts and Future Directions

This study provides insights into the lived experiences of upward transfer women as they navigate universities and develop multiple ways of identifying with CS, pointing to the need for institutions to refine existing policies (e.g., articulation agreements) to support students throughout their programs and encourage balanced workloads before and after transfer. Perhaps most importantly, policy interventions should recognize variation in student goals and expectations. For some students, completing their degree efficiently (e.g., in about four years) may be an important goal. For others, that may not necessarily be the case. Supporting upward transfer women's success requires us to appreciate this diversity, as opposed to standardizing degree pathways, timelines, and definitions of success (see Crisp, 2021). At the same time,

universities can work to remove structural barriers, so that transfer students do not have to choose between their wellbeing and completing their degree "on time."

Funding

Figure 1. Model of Upward Transfer Women's CS Identity and Degree Trajectories

Computer Science Performance, Recognition, and Competence
(e.g., being a mentor or tutor)

Computer Science
Identity

Computer
Science Degree
Trajectories

Departmental and Institutional Structures
(e.g., transfer articulation, competitive admission, financial aid, support for basic needs)
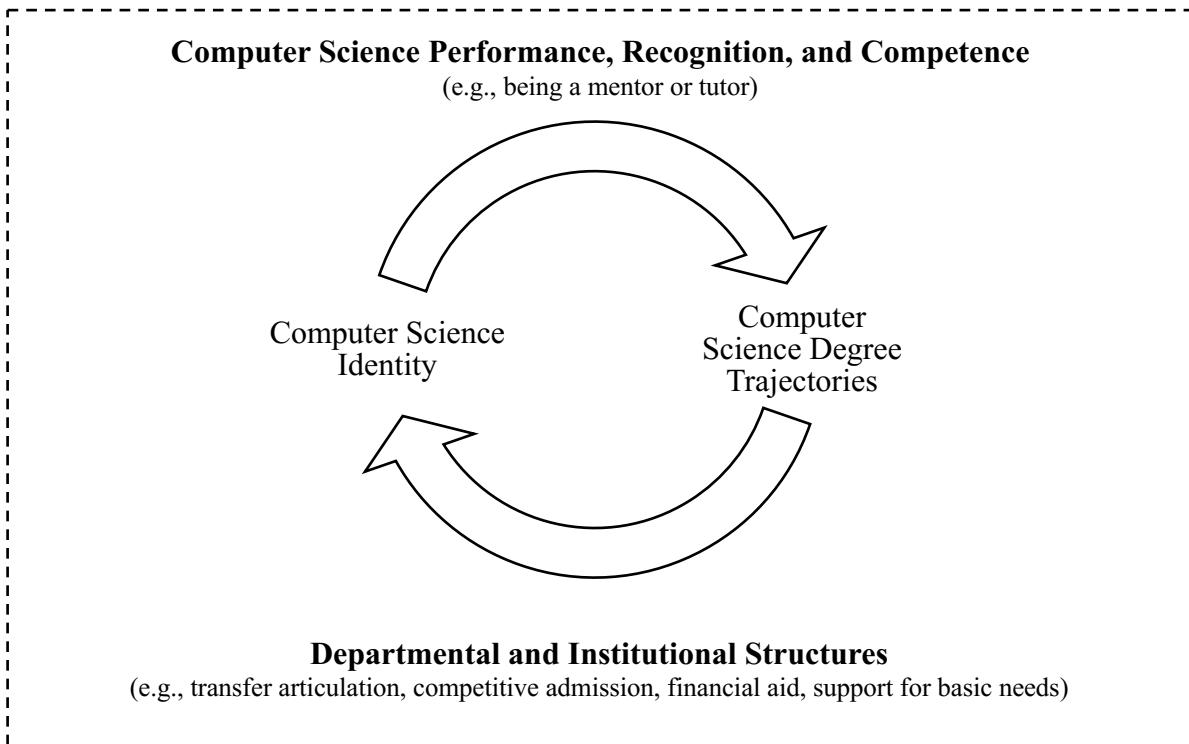
Table 1. List of Participants

Pseudonym	Race/Ethnicity	First-Gen to College	Age	Primary CS Identity (Secondary in Parentheses)	Trajectory Profile
Amelie*	East Asian	No	21	Altruistic (Disrupted)	Efficient linear strategizer
Ann*	East Asian	No	21	Disrupted (Altruistic)	Efficient linear strategizer
Ariel*	Mexican American/Chicana	Yes	21	Altruistic	Pathway adapter
Bea	Black/African American	Yes	24	Prototypical (Disrupted)	Efficient linear strategizer
Em	Mexican American/Chicana	No	20	Disrupted	Efficient linear strategizer
Gray*	White	No	25	Disrupted	Efficient linear strategizer
Kate	White	No	29	Altruistic	Pathway adapter
Maya	Asian/Punjabi	No	Missing	Disrupted (Prototypical)	Efficient linear strategizer
Rose*	Southeast Asian	Yes	Missing	Prototypical	Efficient linear strategizer
Sara*	East Asian and Southeast Asian	No	24	Disrupted	Pathway adapter
Shay	Middle Eastern/Persian	No	21	Altruistic	Detoured persister
Tuen	East Asian	Yes	21	Disrupted	Efficient linear strategizer

Note. Students selected their own pseudonym at the beginning of the interview. Race/ethnicity refers to the most specific racial and ethnic identities that students reported on the survey. Additionally, students sometimes discussed more specific ethnic identities and other social identities in the interview, which I reference in the manuscript. *Indicates that participants completed an extended member check in the form of a follow-up interview, which I analyzed alongside baseline interview transcripts.

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