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Understanding Men’s Disengagement from Computing: A Qualitative Study of High-Performing Non-Majors

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Abstract

In today's technology-driven society, there is an increasing demand for individuals who possess both computer science (CS) knowledge and expertise in non-CS domains to fill interdisciplinary computing roles. Additionally, despite decades of research, the computing field continues to show persistently low representation of women. This paper is part of a larger project aimed at understanding why women choose to disengage from computing. The specific purpose of this paper, however, is to explore why men choose to disengage from the field, in order to highlight gender-based differences to inform the broader project.

This qualitative study investigates why high-performing men in introductory computer science courses, who are not majoring in CS, decide not to pursue a CS minor. Focusing on this group serves two primary goals. First, it offers new insights into how the computing field might better engage students from non-CS disciplines, thereby broadening both the size and diversity of the computing workforce. Second, by examining men's experiences alongside prior research on women's disengagement, the study provides a clearer picture of whether barriers to engagement are gender-specific or reflect broader challenges faced by all students. This perspective also provides insight into an understudied population within the computing field.

Guided by Bronfenbrenner's Ecological Systems Theory, the study adopted a systems approach to inform the interview protocol. Interviews were conducted with six men and analyzed using thematic analysis. Results indicate that participants chose not to pursue a CS minor due to frustration with their course experiences, a perceived lack of value in joining the CS community, and the belief that they could learn computing skills independently while pursuing stronger interests in other fields.

1 Introduction

There is a growing demand for individuals with knowledge in computer science, driven by the increasing reliance on technology in fields even outside of computer science (Schibelius et al., 2022). For example, by 2026, 1.2 million jobs in the computer science industry are projected to go unfilled (Bureau of Labor Statistics, 2021), and this gap is expected to widen over the next 5 years (Krutsch, 2022). These unfilled positions represent a significant barrier to economic growth and technological advancement (Stephenson et al., 2018). While much research has focused on attracting and retaining students in computer science degree programs (Amelink et al., 2018; Biggers et al., 2008; Cheryan & Plaut, 2010; Giannakos et al., 2017; Peckham et al., 2007), one crucial pool of untapped talent is overlooked: students majoring in non-CS fields who are already taking introductory computer science courses and may be well-suited to pursue a computer science minor.

Students in non-CS fields who excel in introductory computer science courses are particularly well-positioned for interdisciplinary roles, which are increasingly in demand in today's tech-driven world (Brodley & Barr, 2022). These individuals bring expertise from their primary disciplines, coupled with the foundational skills of computer science. As industries across sectors seek professionals who can bridge gaps between technical knowledge and domain-specific applications, these interdisciplinary professionals become critical in driving innovation and solving complex problems (Han et al., 2023).

Another untapped talent pool that many prior studies have focused on is women (Engineering and Engineering Technology by the Numbers, 2022). A significant body of research has explored why women are less likely to enter or remain in computer science. But despite growing insights into the factors behind the gender gap in computer science, most research has overlooked men's perspectives on disengagement, even though men's choices significantly influence gender ratios (Cheryan et al. 2017). By focusing on men's perspectives, this study provides a foundation for comparing findings across research that focuses on women's decisions to identify gender specific patterns. This work is part of a larger research project examining the factors that lead both men and women to disengage from computing, with the goal of understanding how gendered experiences and choices shape participation across the field.

The purpose of this paper is to address these gaps in the literature by investigating why high-performing men in introductory computer science courses, who are not majoring in computer science, choose not to pursue a computer science minor. By focusing on this group, the study achieves two key goals. First, it offers new insights into how the computer science field can better engage students from non-CS disciplines, thereby increasing both the number and diversity of individuals entering computing-related careers. Second, by examining men's experiences in relation to prior research on women's disengagement, the study provides a clearer understanding of whether the barriers to engagement are gender-specific or represent broader issues that affect all students. This perspective will help distinguish between gendered challenges and those that might be experienced universally across various student populations.

2 Background

2.1 Attrition and Retention in computer science

Student attrition in computer science is influenced by a mix of academic, personal, and contextual factors. Students who feel confident in their abilities and find coursework manageable are more likely to persist (Pappas et al., 2016), while financial issues, health concerns, family responsibilities, and low attendance hinder retention (Setosta et al., 2017). Negative perceptions of CS and limited understanding of what CS careers entail also contribute to dropout (Carter, 2006; Rosson et al., 2011).

External portrayals of the field further influence students' sense of belonging. Media stereotypes commonly depict computer scientists as socially awkward "nerds" with narrow interests and limited interpersonal skills (Beyer et al., 2003; Kendall, 2011; Margolis & Fisher, 2002; Mercier et al., 2006), often emphasizing solitary programming and technology-centric hobbies (Cheryan et al., 2009, 2011). These portrayals, summarized by Cheryan et al. (2013) as a genius male hacker with little social life, can discourage students who do not identify with such images. Because students evaluate their potential fit by comparing themselves to perceived professionals (Creamer et al., 2007), mismatches between self-image and stereotype can undermine persistence and contribute to CS attrition.

2.2 Gendered Barriers in Computer Science

Research on women's attrition in computer science has identified key barriers such as gender stereotypes, masculine classroom cultures, and everyday sexism that undermine persistence (Eagly et al., 2000; Riegle-Crumb et al., 2019; Falkner et al., 2015; Lapan & Smith, 2023). Women often navigate biased expectations, exclusionary interactions, and discriminatory comments, while also grappling with lower self-efficacy, fluctuating belonging, and identity misalignment with the perceived male-dominated field (Beyer, 2008, 2014; Good et al., 2012; Lehman et al., 2016; Blackburn, 2017; Cheryan et al., 2017). These factors collectively contribute to women's loss of interest and departure from computing (Beyer et al., 2003; Diekman et al., 2010).

These dynamics reinforce a cycle of gender disparity. Attrition reduces the presence of women in the field, limiting access to female role models who are shown to support persistence (Yates & Plagnol, 2022). In turn, the scarcity of women strengthens stereotypes that computing is a male domain, weakening students' sense of belonging and identification with the field (Eagly et al., 2000; Cheryan et al., 2011). This cycle of exclusion and underrepresentation perpetuates challenges for women considering or pursuing careers in computer science.

2.3 Men's Experiences in STEM

Men's experiences in STEM share both similarities and differences with those of women. Like women, men develop belonging through being heard, contributing, forming relationships, perceiving competence, and cultivating interest and science identity (Corson & González-Morales, 2024; Rainey et al., 2018). However, men more often frame belonging in terms of merit and success and tend to assume that all students can achieve belonging. Men also report earlier STEM interest, often fostered through tinkering, solitary activities, and media exposure (Maltese & Cooper, 2017). They "over-persist" in STEM, retaking failed courses even when doing so carries long-term penalties (Penner & Willer, 2019). For men, interest is a primary driver of persistence, with relatively few switching out of STEM (Maltese & Cooper, 2017), and when they do leave, poor performance and negative teaching experiences are key factors (Maltese & Cooper, 2017).

Despite men's overall overrepresentation, demographic variation exists across STEM fields and intersecting identities. Men dominate computing, engineering, and the physical sciences but are underrepresented in math, life sciences, and health-related STEM (Fry et al., 2021). Additional disparities emerge for men with disabilities (Cech, 2022), men in same-sex relationships (Sansone & Carpenter, 2020), and men of color, particularly Black, Hispanic, and Native American men (Funk, 2021). In contrast, white, able-bodied, heterosexual men remain most dominant in STEM spaces, benefiting from greater inclusion, respect, opportunity, and persistence while often remaining unaware of how race and gender shape outcomes for others (Dancy et al., 2020; Cech, 2022).

2.4 Choosing an Academic Field

Several frameworks help explain how students choose academic fields, including minor selection. Personality-based models such as McCrae and Costa's Five-Factor Model (1999) and Holland's Theory of Personality and Vocational Choice (1959) suggest that individuals gravitate toward fields aligned with stable traits and vocational interests. Research finds that students in different majors exhibit distinct personality profiles (Balsamo et al., 2012), and those with stronger investigative traits are more likely to enter STEM fields than those with artistic orientations (Chen & Simpson, 2015).

Social Cognitive Career Theory (SCCT) further emphasizes the interplay of personal, behavioral, and contextual factors in shaping interests, goals, and actions (Bandura, 1986; Lent et al., 1994). For STEM students, interest, preparation, career opportunities, and societal impact influence field selection (Maltese & Cooper, 2017; Alshahrani et al., 2018). While little work has examined minors specifically, a case study of a computing minor for social science majors found that students enrolled to build data skills, enhance employability, and gain future-relevant computing knowledge, with 87% reporting interest in applying the minor to careers or advanced study (Carr et al., 2021).

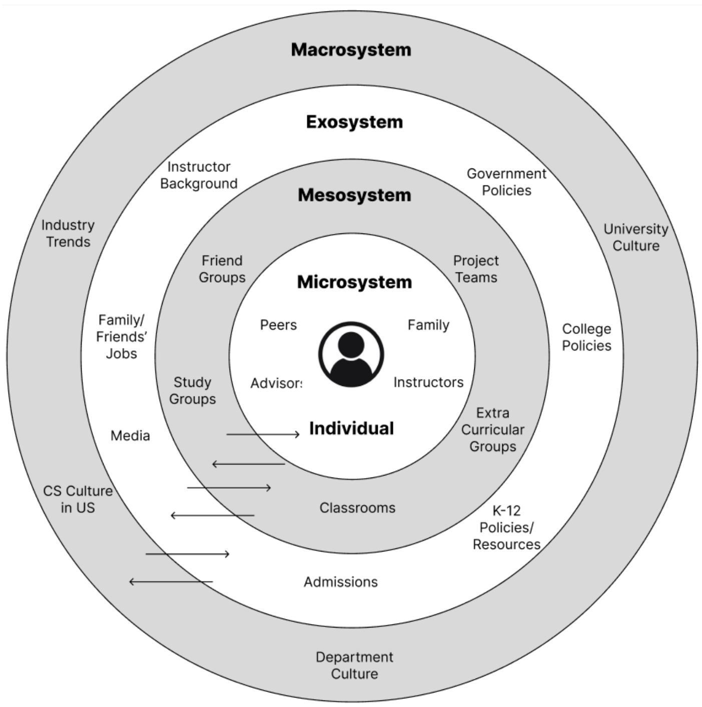
3 Theoretical Framework

The theoretical framework for this study is Bronfenbrenner's Ecological Systems Theory (Bronfenbrenner, 1979). This theory emphasizes an individual's decision-making within the context of multiple, interconnected layers of influence. By focusing on the individual within their environment, it highlights not only personal factors but also the role of relationships and external influences, which can affect the individual even when they are not directly involved in the environment. Bronfenbrenner's framework consists of four environmental layers:

1. **Microsystems**: These are settings and relationships directly experienced by the individual, such as interactions with family, peers, academic advisors, and instructors.
2. **Mesosystems**: This level encompasses the connections between microsystems, such as classroom settings, study groups, or project teams where different parts of the individual's environment interact.
3. **Exosystems**: These are settings in which the individual is not directly involved but is still influenced by, like college policies, admissions processes, or the priorities of instructors.
4. **Macrosystems**: This level includes larger societal influences, such as industry trends or the cultural climate of the university or department and computer science as a field.

Figure 1 illustrates these layers, with each successive level containing the one below it, placing the individual at the center. By organizing the environment in this way, Bronfenbrenner's framework underscores the environmental influences on an individual, which is crucial for understanding academic decisions, such as choosing or changing a major or pursuing a minor. This ecological approach, in contrast to more individual-focused frameworks, allows for a deeper exploration of how external factors shape academic choices, especially in the context of academic transitions.

Figure 1 Adapted Bronfenbrenner's Ecological Systems Theory



Ecological Systems Theory has been applied to explain a range of educational and STEM outcomes, including engineering major choice among students of color (Onal & Temko, 2024) and broader engineering persistence (Ngambeki, 2012). It has also been used to examine underrepresentation in gifted programs (Crawford et al., 2020), student belonging (El Zaatari & Maalouf, 2022; Glisson, 2023), and experiences in computer science higher education (Arishi et al., 2024). This study adopts an asset-based framing of attrition, focusing not on deficits but on how high-achieving students' interactions with their environments influence their decisions to disengage from computer science, an approach well aligned with Bronfenbrenner's theory.

Bronfenbrenner's framework guided the interview protocol. Questions targeted multiple system levels: microsystem interactions with peers, instructors, and family; mesosystem classroom dynamics; and macrosystem perceptions of the broader CS community and future plans. Although the exosystem was not explicitly probed, interviewers attended to policy- or process-related influences when students raised them. The protocol is included in the Appendix.

4 Methods

The study examined high-performing male undergraduates from non–computer science majors who enrolled in an introductory computing course designed for non-CS students at a large public research university. During the spring and fall semesters of 2023, students in one of five introductory computing courses were invited to complete a demographic survey that included an option to participate in a follow-up interview. From this survey pool, six participants were selected based on self-reported high academic performance (earned an A or B in their introductory computing course) and stated interest in the study. Recruitment continued until additional interviews failed to yield new insights, indicating thematic saturation. Participants were primarily selected to represent a range of non-CS majors, with racial and ethnic diversity serving as a secondary consideration. A summary of the participants' demographic details is provided in Table 1.

Table 1. Participant Demographics

Pseudonym	Race/ Ethnicity	Major	Prior Programming Experience	Course Taken
Trevor	White	Chemistry	• AP Computer Science in high school • Engineering course in high school	• Introduction to Python
Ishan	Other	Financial Technology (minor in Math)	• None	• Introduction to Python • Introduction to Software Design • Software Design and Data Structures
Min	Asian	Computational Modeling and Data Analytics (minor in Math)	• AP Computer Science in high school • Community College dual enrollment in cybersecurity academy	• Introduction to Python • Intermediate Python
Amir	Multiracial	Civil Engineering	• Two high school programming courses	• Introduction to Python
Omar	Multiracial	Cybersecurity Management Analytics	• Self-taught Kahn Academy in high school	• Introduction to Python
Brady	White	Economics	• AP Computer Science in high school	• Introduction to Python

Semi-structured interviews were conducted remotely and lasted approximately 30 minutes. Interviews focused on students’ experiences in their computing courses, their perceptions of computing, and their future academic and career plans. The interview protocol was informed by Bronfenbrenner's Ecological Systems Theory, and questions probed students' interactions with peers and instructors (microsystem), classroom environments (mesosystem), and perceptions of the broader computing community and future trajectories (macrosystem). Interviews were audio recorded, transcribed, and verified for accuracy.

Interview data were then analyzed using reflexive thematic analysis (Braun & Clarke, 2006; Clarke & Braun, 2017). After becoming familiar with the transcripts, initial inductive codes were generated to capture meaningful features of the data. Codes were iteratively grouped into candidate themes, which were reviewed and refined to ensure coherence and relevance to the research question. Themes that lacked sufficient support or analytical value were discarded, and final themes were defined and named to represent the central patterns within the dataset.

4.1 Author Positionality

The first author identifies as a woman in computer science, though her path to the field began outside of it. Initially a math major, she took a single computer science course to meet a degree requirement and found it to be an enjoyable experience. Motivated by this newfound interest, she decided to pursue a computer science double major, ultimately earning both a bachelor's and a master's degree in computer science. These personal experiences enable her to connect with participants, who, like her, initially engaged with the field as non-majors in introductory computer science courses. However, unlike the participants, she ultimately chose to pursue computer science further, allowing her to draw meaningful comparisons in interpreting their decisions to disengage from the field.

The second author identifies as a woman engineer and currently serves in both administrative and faculty roles within a large computer science department at an R1 university. Over the past 15 years, she has worked extensively with individuals in technology-related fields and has consistently observed persistent stereotypes and a lack of support for students. Through her research, service on departmental committees, and student mentorship, she is dedicated to reducing barriers in the field of computer science and fostering a more inclusive and welcoming environment where all students can succeed.

5 Results

Through thematic analysis, three key factors were identified that shed light on why participants chose not to pursue a computer science minor: course experiences, community belonging, and interest. Each of these factors is explored in greater detail in the sections that follow.

5.1 Course Experiences: Men were frustrated with their computer science courses

Participants encountered a variety of experiences in their introductory computer science courses that influenced their decision to disengage from the field. These experiences were shaped by several key aspects of the course, including the structure of the course, course assignments, and the social dynamics within the course.

5.1.1 Frustration with Course Difficulty and Connection

Participants cited both the difficulty and ease of the course as reasons for disengagement. For example, Omar found the pacing problematic, noting that equal instructional time was allocated to both basic concepts like print statements and more complex topics like loops, which became overwhelming towards the course's end, leading him to turn away from further computer science courses. Compared to someone like Min, who reported that much of the course material covered content he already knew, leading to feelings of redundancy that fueled his disengagement. He expressed frustration that he was not allowed to skip the course despite his prior knowledge, believing he should have received credit without participation. Min was also irritated by peers asking him basic questions in class, feeling that such queries could be resolved through simple online searches.

> *"I think I should have skipped intro to Python. I think they should have given me credit for it. I think I should have just took an exam to get out of that class. That class, that class was at least the professor was engaging or else the class would've been boring for me because it was a long walk to that class. And I sometimes I just wish I just didn't go to the class"* -Min

Additionally, participants expressed a sense of disconnection from the course content, perceiving it as lacking practical application or personal relevance. Ishan, for example, criticized the course for its limited focus on real-world applications, arguing that without opportunities to apply the material in meaningful contexts, the knowledge felt superficial and difficult to retain. He contended that the course content could easily be self-taught and questioned the value of the formal class structure, suggesting that it did not offer added benefits beyond independent learning.

5.1.2 Criticism of Course Assignments

A recurring source of dissatisfaction among participants was the format and implementation of course assessments, particularly quizzes. Several participants expressed frustration with the emphasis on memorization required for quizzes, contrasting this with the more applied, open-ended nature of programming projects.

> *"The quizzes were fairly challenging because you had to you didn't have any reference material when you were doing them, so you had to do it all from memory, which on the one hand is understandable, but I feel like it's also not really indicative of a development environment"* -Trevor

Trevor criticized this assessment format, arguing that it did not reflect authentic programming practices where referencing documentation and external resources is common. This disconnect between assessment methods and real-world programming environments led to feelings that the quizzes were not meaningful indicators of their coding abilities. In addition to concerns about relevance, participants were dissatisfied with the grading practices associated with quizzes. Amir expressed frustration with what he perceived as arbitrary grading, noting that TAs were often unable to provide clear justifications for the grades assigned. This lack of transparency in evaluation contributed to a sense of unfairness and further diminished perceptions of the value of these assessments. In addition to quizzes, Amir also noted that project descriptions were often unclear and required extra support to identify what was being asked. He admitted that, despite his prior experience, some projects were difficult and required attending office hours for additional support.

"In the course, I went to office hours a lot, particularly for the project because we had three big projects. If I didn't go to office hours, they would have been impossible" -Amir

5.1.3 Lack of Social Engagement and Field Misalignment

A prominent negative experience and source of frustration discussed by participants was the perceived lack of social interaction and community within the classroom environment. Multiple participants described their classes as isolating, with limited opportunities for collaboration or meaningful peer engagement.

"Most of the people that I interacted with were some of my friends from outside the class already. I already knew them for the most part and I guess that's really kind of the only community that I had in that class." -Brady

Trevor noted that the course did not foster a close environment, while Amir described classmates as pretty closed off, making it difficult to form connections. Brady echoed this sentiment, stating that his interactions were limited to friends he already knew prior to the course, rather than forming new relationships within the class. This lack of social connection was particularly concerning given the collaborative nature of professional computer science work. Ishan explicitly criticized the course's emphasis on independent work, arguing that discouraging collaboration runs counter to real-world programming practices, where teamwork and code reviews are integral.

"I will say the lack of allowing for collaboration, bad. It's cool, it's fine. You say, okay, you have to do everything yourself. I get it right. But if you're preventing people from collaborating, then that literally goes against how CS is in real life." -Ishan

Many participants found the course setup counterintuitive to the field of computer science and would have preferred group work over individual assignments. The independent and isolating nature of the course led them to avoid pursuing similar types of computer science courses, ultimately disabling them from obtaining a computer science minor.

5.2 Community Belonging: Men place little value on belonging within the computer science community

Many participants associated the computer science community with those formally pursuing a computer science major, a definition that emphasized a shared passion and depth of knowledge in the field. For example, Brady described computer science majors as individuals deeply knowledgeable about the subject, eager to expand their expertise, and often serving as go-to resources for peers seeking guidance. Similarly, Trevor broadened this definition to include math majors, recognizing the significant overlap in coding and computational thinking within their coursework.

“My initial impression, not that I have anything to base it off of, it seems as though the computer science community is comprised mostly of people directly in computer science. Maybe in mathematics too, actually, now that I think about it. So a professor who said he collaborated with people in the CS department” -Trevor

Alternatively, several participants conceptualized the computer science community as open to anyone with an interest in being part of the field. Amir viewed community membership as a matter of self-identification, suggesting that it holds subjective significance rather than objective criteria.

“If they want to be, you know, it's just an identification thing, it's not really, it doesn't have any real substrate to it.” -Amir

In contrast, Min acknowledged a minimal knowledge threshold for community inclusion but argued that this requirement was easily attainable, reinforcing the idea that the computer science community is accessible to those willing to engage.

Participants expressed mixed feelings about their sense of belonging within the computer science community, reflecting both insider and outsider identities. Min identified as an insider based on his proficiency and active engagement with computer science concepts. Conversely, Ishan described himself as partially an outsider despite his strong technical skills, which highlights his self-efficacy within the field. He articulated that while he could comprehend complex programming discussions, he lacked experience in building sophisticated systems. Ishan framed insider-outsider status as roles that represent different life experiences rather than hierarchical positions or knowledge.

“So knowing more than you and being in a different field are two different things. So okay, someone can know more than me and they're in their field completely, understandably because they've spent the same amount of time that I spent in my field and their field. So I think like when someone knows more than me in my own field, that's what I'm like, oh, I got to step my game on it. It's feeling it like an outsider is not. I don't, I don't think it's inherently feeling like you know less or you're like inadequate or anything like that. Feeling like outsider means that they have literally just spent more of their time. Part of their life is different because of what they do compared to what you do.” -Ishan

For those who identified fully as outsiders, this designation was not associated with negative emotions. Trevor, for example, acknowledged his outsider status but did not feel excluded, attributing this to his STEM background, which he believed garnered respect from computer science peers. Amir similarly perceived himself as an outsider, not due to exclusion but because he felt no intrinsic need to affiliate with the computer science community, aligning with his belief that community membership is a personal choice. Brady echoed this sentiment, noting that while he found computer science enjoyable and regarded the community positively, his lack of deep passion for the subject reduced his desire to immerse himself within it.

"I mean, I'm assuming it's a fine community but I mean, computer science is just kind of like it's another area, it's another field. It's not like a burning passion that I have. So it's cool to learn a fun to be around, don't need to be around it, you know." -Brady

Despite these varied self-perceptions, participants consistently described the computer science community as friendly and welcoming.

"I don't really feel like unwelcomed at all" -Omar

Ishan highlighted the abundance of shared resources and collaborative opportunities in the broader field, such as Youtube and Stack Overflow, as indicators of an inclusive environment. Min emphasized the community's openness to dialogue, and Brady remarked on the overall welcoming nature of computer science spaces. This framing highlights a welcoming community where, even when individuals identify as outsiders, their decision not to pursue a computer science minor is not rooted in a lack of belonging. However, even those who identified as insiders acknowledged that their sense of belonging was subjective and lacked a deeper meaning. And many participants did not feel the need to identify as outsiders, further suggesting that belonging to the community was not a primary factor in their decision to pursue a minor. Ultimately, it appears that community and belonging have little influence on men's choice to pursue a computer science minor.

5.3 Interest: Men have greater interest in other fields and can learn and connect these fields to computer science on their own

The majority of participants expressed a clear interest in computer science, often explicitly stating their fascination with the subject or their enjoyment of the introductory course. This interest manifested in several ways, including intentions to enroll in future computer science courses, engagement with personal projects, and aspirations to integrate computer science knowledge into their careers and other academic fields. Several participants demonstrated their interest by planning to take additional computer science courses. For instance, Min was already enrolled in a Java Data Structures course for the following semester, indicating a strong commitment to further study computer science despite not declaring a formal degree. Similarly, Omar expressed interest in taking an Introduction to JavaScript course in the future, though without immediate plans. However, not all participants intended to continue formal computer science education. Some, like Ishan, cited scheduling constraints rather than a lack of interest as barriers to further engagement. Ishan expressed a desire to take advanced courses such as Quantum Computing or Parallel Computing but was unable to do so due to being in his final semester with a full course load.

"So I think like if I had the time, I would definitely be taking something like quantum computing or like maybe parallel computing or something." -Ishan

Amir also chose not to enroll in additional computer science courses but noted that his CS-related learning would continue through computing courses offered within his major, Civil Engineering, such as "Computer Applications in Civil Engineering."

Interest in computer science extended beyond the classroom, as evidenced by participants' involvement in personal projects. Min, for example, developed advanced projects beyond the course curriculum, including scripts that could start or stop with a clap command.

"I usually did do extra work out assignments like my own personal projects. That was because those projects were useful for my day to day cases. Okay. All right. But it was more advanced than what's taught in class because I would write scripts that would like play pause when like I clapped my hand or something" -Min

Ishan applied his computer science skills to a financial technology capstone project, building a Principal Component Analysis (PCA) model. These examples illustrate how participants leveraged their computer science knowledge in creative, self-directed ways. Moreover, participants frequently discussed the interdisciplinary application of computer science, highlighting their enthusiasm for combining computer science with their primary academic interests. Min expressed a strong interest in integrating computer science with mathematics, while Amir focused on applying coding skills within the context of civil engineering.

"Yeah, absolutely. When I used Mat Lab I found it to be so helpful and interesting. It made me like computer science a little more. I know it's not fully computer science, but it is really just coding. The application of coding to something like civil engineering, where you could see graphs come out and really just make it do whatever you want. That was really cool. I genuinely enjoy that course, even though it's probably the hardest one I took last semester." -Amir

For some participants, the introductory course served as a catalyst for recognizing the broader potential of computer science. Omar, for example, expressed that the course helped him envision a future where he could engage more deeply with computer science, suggesting an increased openness to incorporating computer science into his academic or professional trajectory. Similarly, Brady highlighted his newfound awareness of the diverse and expansive applications of computer science, noting that the course broadened his understanding of how computer science can intersect with various fields and industries.

"my understanding changed mostly just like in the amount of things that I figured out that I could do with it, even in some of the smallest, like outside tasks, use it like you wouldn't really think of like oil field workers as needing computer science to do their jobs." -Brady

As a result of this new understanding, participants also envisioned using computer science in their future careers, even if they did not plan to minor in the field. Those with defined career goals consistently indicated that programming would play a role in their professional lives.

"There's a good chance I'll have to use computing in my future career with respect to say, data analysis, like I think most chemistry instruments use R, or something proprietary otherwise. Okay, Yeah, my future career looks like it's going to be a lot of data handling. Of course, I'm going to need to do computing." -Trevor

Trevor anticipated a career involving substantial data handling, necessitating computing proficiency. Brady, with aspirations to become a military pilot, recognized the relevance of computer science in aviation technology. Even participants like Omar, who were uncertain about their specific career paths, acknowledged that programming would likely be part of their future work.

Despite this widespread interest, it was not sufficient to motivate participants to pursue a computer science minor. For some, their passion for other fields, such as economics or civil engineering, outweighed their interest in computer science. However, these individuals did not view this as a binary choice, as they actively sought to integrate computer science knowledge into their primary areas of study. Others recognized that, while they found computer science intriguing, it did not captivate them enough to warrant a commitment. Amir, for example, considered majoring in computer science but was deterred by concerns about the evolving job market, particularly the impact of artificial intelligence on entry-level programming roles. He preferred the application of computer science within civil engineering rather than computer science as a standalone discipline. Similarly, Brady acknowledged his interest in computer science and his intention to continue learning about it informally but concluded that it did not sufficiently inspire him to pursue it as a minor. Ultimately, men are not pursuing a computer science minor not due to a lack of interest, but because they lack interest in a formal qualification. Our participants have the ability and desire to learn independently or take specific computer science courses that align with their interests, even without earning a minor. They are able to apply computer science to their other passions on their own terms, which leads them to feel no need to obtain a computer science minor.

6 Discussion

Our findings show that multiple ecological system layers influenced participants' decisions not to minor in computer science. Men tended to interpret micro-, meso-, and exosystem experiences through a broader macrosystem lens, using perceptions of the computer science field to evaluate rather than construct new understandings. Their career decision-making was shaped less by classroom-level experiences and more by whether these aligned with preexisting beliefs about computing, suggesting that course-level interventions may be insufficient without also addressing broader perceptions of the field.

6.1 Individual

At the individual level, interest and belonging shaped decisions, but in nuanced ways. Participants expressed genuine interest in computing yet felt stronger alignment with other fields. When they did integrate computing into their interests, it was driven by their own understanding of the field (macrosystem), not by classroom or interpersonal influences. Notably, participants described belonging not as a barrier but as a non-factor. While a few acknowledged they did not "fit," this was framed as personal preference rather than exclusion, consistent with work showing men in STEM more readily experience belonging and interpret lack of participation as a choice rather than a constraint (Banchefsky et al., 2019; Daniels et al., 2019). For these men, the key question was not whether the field would welcome them but whether the field, as they understood it, aligned with their goals and identity, a framing more closely tied to domain identification than to social belonging (Osborne & Jones, 2011).

6.2 Microsystem

Microsystem influences were limited and did not commonly discourage students from pursuing the minor. Although isolated frustrations surfaced, such as peer dependence or unclear TA grading, there was little evidence of direct interpersonal deterrents. More notable was the absence of meaningful interaction within this layer, shaped by mesosystem structures that constrained opportunities for engagement.

6.3 Mesosystem

At the mesosystem level, participants critiqued course structure, pace, and assignments, noting a lack of real-world application and collaborative engagement, features linked to STEM persistence (Van Wart et al., 2014; Davis & Burkholder, 2024; Gharbaoui et al., 2024). Prior experience and macrosystem perceptions shaped expectations for the course, and when these expectations were unmet, students disengaged not from computer science as a field but from the course itself. Course experiences thus served as a test of field authenticity rather than a mechanism for reshaping perceptions.

6.4 Exosystem

Institutional structures also influenced decisions. Participants cited schedule constraints, unclear pathways, redundant requirements, and limited flexibility as barriers to pursuing the minor. Some opted for computing-related coursework offered through other departments that better aligned with their goals. These findings align with prior work identifying structural barriers to computing pathways (Ganesan et al., 2025; Smith, 2024) and suggest that improving participation may require not only reframing the field but reforming curricular pathways to be more adaptable and interdisciplinary.

6.5 Macrosystem

The macrosystem ultimately carried the most weight. Participants entered the course with preexisting perceptions of computer science, shaped by prior experience, which is more common among men (Du & Wimmer, 2019), and evaluated course experiences against those beliefs. They described the course as overly basic or insufficiently applied, contrasting with findings that non-CS students often prefer courses tailored for their backgrounds (Dawson et al., 2018). Critiques extended beyond pedagogy to structural rigidity, such as lack of test-out options, reflecting a perceived misalignment between institutional structures (exosystem and mesosystem) and what they believed the field requires at the macrosystem level.

7 Recommendations

Our findings suggest several recommendations for policy and practice to support continued engagement in computer science among non-CS major men. Introductory courses should reflect real-world practices, both in application and social engagement, incorporating collaborative assignments early to foster teamwork, communication, and problem-solving skills. Thoughtful course design can mirror industry environments, build peer support, and enhance learning experiences, helping students connect classroom experiences with broader field expectations.

Courses should also accommodate a range of prior experience and abilities. Flexible project options, optional challenges for advanced students, and systems for assessing existing knowledge can prevent disengagement and allow students with prior experience to bypass redundant material. Beyond course design, departments could create more adaptable pathways that align with students' interests and career goals, enabling them to acquire relevant skills without completing all required foundational courses. Such flexibility may increase accessibility, engagement, and participation while supporting a broader diversity of perspectives and expertise in interdisciplinary roles.

8 Limitations and Future Work

This study has several limitations. Data were collected from students at a single large, public R1 university, so findings may not generalize to other contexts. Most participants had prior programming experience, meaning results may not reflect the perspectives of students encountering computing for the first time. Additionally, participants took the course across different terms and instructors, and variations in content or teaching style could influence outcomes. All participants self-reported strong academic performance, so results may not capture the experiences of students with more varied achievement levels.

Future research could address these limitations through longitudinal studies to track changes in students' perceptions over time, examine which prior experiences most strongly shape initial views of computing culture, and explore how micro- and mesosystem-level experiences, such as classroom interactions or peer dynamics, interact with broader macrosystem perceptions. Studies including more diverse academic backgrounds and performance levels could provide a fuller understanding of men's engagement and decision-making in non-CS computing courses.

9 Conclusion

This study examined six high-achieving non-CS major men who completed an introductory computing course for non-majors to understand why they chose not to pursue a computer science minor. Thematic analysis revealed several factors influencing this decision, including perceptions that the course lacked rigor, limited real-world relevance, unengaging assignments, and few opportunities for social interaction. Participants also reported little interest in cultivating a sense of belonging in computer science and were more committed to other academic disciplines, feeling confident they could acquire necessary computing skills independently without completing the minor.

Viewed through Bronfenbrenner's ecological systems theory, participants' perceptions of computing were shaped less by immediate academic experiences (micro- and mesosystems) or institutional structures (exosystem) and more by preexisting macrosystem beliefs formed through prior exposure to computing. These findings suggest that interventions at the introductory course level may have limited impact on men's decisions, highlighting the need to address broader cultural narratives and earlier experiences to influence engagement and participation in computer science.

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