Why Do Students Enroll in AP CSP?

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***Abstract*—CS4All initiatives nationwide have been working to increase and diversify student participation in computer science (CS). One intentional effort to broaden participation in CS was the launch of the Advanced Placement (AP) CS Principles (CSP) course, which sought to increase the number of students enrolling in CS overall as well as from groups historically underrepresented in CS. Early AP CSP implementation results are encouraging and have identified the need to better understand essential supports for quality implementation, differential student experiences and outcomes, and students' motivations for course enrollment. In this paper, we explore the motivations that affect student decisions to take AP CSP using survey data collected during fall 2019 in the New York City public schools, the largest school district in the U.S. This work is part of an ongoing research-practice partnership that provides teacher and school supports for AP CSP implementation and aims to improve outcomes especially for female, Black, and Latinx students in high-need schools. In particular, we examine how students' reasons and influences for enrolling in AP CSP may differ based on self-identified gender and race/ethnicity. Our findings indicate that while most students shared an interest in learning more about CS, students from communities historically underrepresented in computing are more likely to report being placed in the course and to be influenced by guidance counselors. The implications of these results highlight the importance of understanding why students choose AP CSP in developing recruitment resources, student engagement strategies, and supports for implementation.**

Keywords—equity, computer science education, high school computer science, AP CSP, student enrollment, research-practice partnership, broadening participation

I. Introduction

In recent years, the National Science Foundation (NSF) and others have called attention to the long-standing underrepresentation of women, persons with disabilities, and people who are Black, Latinx, or Native American in computing at the post-secondary level and in careers [1]. There has been tremendous growth in efforts to broaden participation in computer science (CS) and to introduce CS to K–12 students. These efforts recognize the need for greater representation in computing given projected workforce needs and the broader need to diversify the science, technology, engineering, and mathematics (STEM) workforce [2]. They also respond to the imperative to engage the talents, creativity, and perspectives of our diverse population to foster innovation and strengthen the impacts of computing education. Given the centrality of computing and technology to our society, access to CS education has been identified as key to addressing broader equity issues in society.

High school Advanced Placement (AP) CS courses have been a particular target of equity efforts in CS. To address persistent disparities in high school participation in AP CS—particularly among students from communities historically underrepresented in computing—the College Board, with the NSF, introduced the AP Computer Science Principles (CSP) course and exam. The goal of AP CSP is to broaden participation in CS by making the field more attractive and engaging to female students, Black students, Latinx students, and other students underrepresented in computing [3].

AP CSP has been rolled out in New York City (NYC), the largest public school system in the U.S., as part of the NYC Department of Education (DOE) CS4All initiative. The NYCDOE Computer Science Education Team, a pioneer in advancing CS education and broadening access to CS with an emphasis on female, Black, and Latinx students (language used by CS4All initiative and throughout this paper) launched AP CSP in 2015. Equitable implementation of the AP CSP course has been central to achieving the initiative's goal of providing meaningful, high-quality CS education to all NYC public school students. Education Development Center (EDC) and the NYCDOE CS4All initiative are engaged in a research-practice partnership (RPP) aimed at strengthening AP CSP implementation and increasing the participation of students who are female, Black, and Latinx, particularly at schools that serve students from economically-disadvantaged families.

Our team's current work grew out of an existing partnership, *Beauty and Joy of Computing in New York City* (BJC4NYC), centered on providing professional development to over 150 high school teachers and supporting implementation of the *Beauty and Joy of Computing* AP CSP curriculum [4]. The goals of our current RPP are to enhance and study the teacher and school supports needed to scale implementation of AP CSP courses in high-need NYC high schools, and to increase understanding of the challenges that

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such schools face in implementing AP CSP courses and fostering success in CS for all students. Consistent with the RPP methodology, our team mutually identified and defined a persistent problem of practice in NYC schools—the equitable implementation of AP CSP particularly in high-need high schools which typically serve greater percentages of students from communities historically underrepresented in computing and students from economically-disadvantaged families. In jointly investigating the problem within the district, we found promising increases in students' access to CS learning opportunities and specifically the AP CSP course. Yet disparities in participation—including for students who are female, Black, and Latinx—persist. This led us to further investigate student enrollment in AP CSP, including students' reasons for enrolling in AP CSP and influences that affect students' decisions to take an AP CSP course, as well as school-based strategies for recruiting students to AP CSP.

This paper shares our findings about students' interests and motivations for enrolling in an AP CSP course. We collected the data from a fall survey administered to a sample of students enrolled in AP CSP courses in NYC public schools during school year 2019–2020. Research questions include:

1. What are the reasons students choose to enroll in an AP CSP course?
2. Who and what influence students' decisions to enroll in an AP CSP course?
3. What differences, if any, are there in students' responses to these questions by gender, by racial and ethnic group identification, and by school context?

II. Review of Related Research

This work is informed by research that investigates barriers to equitable participation in CS, reasons for enrolling in high school CS courses, the role of RPPs in studying equity in CS education, and the progress of the AP CSP course.

A. Barriers to equitable participation in CS

It is well documented that opportunities for students to learn CS in high school are limited for female students, Black students, Latinx students, and students from economically-disadvantaged families. Fewer female students, Black students, and Latinx students participate in CS classes, and students from economically-disadvantaged families are less likely to attend schools with access to CS classes [5]. Furthermore, Black students, Latinx students, and Native American students are less likely to attend a school that teaches a foundational CS course [6]. Google & Gallup [7] found that Black students are less likely than White students to have classes dedicated to CS at the school they attend (47% vs. 58%, respectively).

The lack of exposure and access to CS creates disparities in students' opportunities to learn, and persistent social barriers foster narrow views of "who does CS" and can dampen interest and advancement [7]. In a survey of over 1,600 students in grades 7–12, Wang and Moghadam [8] found that students from economically-disadvantaged families, Black students, Latinx students, and female students reported less access to CS learning at school. They also found that structural barriers in access and exposure to CS were prevalent for Black students and Latinx students, while social barriers such as lower awareness of CS opportunities outside of classes, less encouragement from teachers and parents, and less exposure to role models in the media seemed stronger for female students. Prior research has suggested that a sense of belonging in computing is important for supporting student interest and persistence, and even more critical in attracting a diverse population of young women to computing [9]. In one study, high school teachers identified students' perceptions of "who does CS" and feelings of not belonging when in CS classes as barriers to participation in CS by female students, Black students, Latinx students, and students from economically-disadvantaged families [10]. Further, Ryoo and Tsui [11] emphasize the importance of understanding how feelings of belonging and identifying as a CS person may impact one's future CS pathway.

B. Reasons for enrolling in high school CS courses

These persistent barriers have an impact on students' perceptions and are likely to influence why they choose to consider or take a CS course. In fact, there is little research that focuses specifically on student reasons for choosing to enroll in an AP CSP course or even in a high school CS course, and particularly for students from communities historically underrepresented in CS. Existing research has explored the influence that enrollment in an elective high school CS course that emphasizes the personal relevance of CS has on increasing the likelihood that students will take another computing course [12]. Results from a survey of high school students regarding their interest in pursuing CS as a future major include that students' top reasons for choosing a CS major were their interest in computer games, for males, and their desire to use it in another field, for females. The top reason—for both males and females—for not choosing a CS major were related to student perceptions (e.g., not wanting to sit in front of a computer all day) and limited understanding of CS [13]. Other research suggests that students' negative perceptions of computing and lack of understanding of what computer science is can negatively affect student interest in CS [14, 15, 16]. To address these concerns and increase student interest in computer science, efforts have focused on exposing students to the relevance of computing, emphasizing the creative and problem-solving aspects of computer science, and providing social supports such as role models and mentoring for students [14, 16, 17].

C. Role of research-practice partnerships

In recent years, the CS education community embraced RPPs as a mechanism that engages multiple stakeholders in making sense of the complex conditions that contribute to inequities in CS access and participation. RPPs have emerged as a promising strategy for exploring and addressing persistent challenges of practice within education, particularly in complex school settings [18, 19]. These partnerships, designed to bridge research and practice, developed in response to concerns about the timeliness of research results to influence improvement decisions in schools [20] and the challenges for practitioners in interpreting or applying results to specific district contexts [21]. RPPs engage researchers and practitioners in working together to iteratively define and refine research goals, questions, implementation designs, and data collection and analysis methods as well as to review and interpret findings. Early outcomes from the NSF-funded CSforAll RPP program have identified the importance of multi-stakeholder comprehensive PD models and a focus on equity in PD programs as critical for the capacity building of CS education leaders [22]. Another CSforAll RPP team explored the effects of a CS graduation requirement on increased enrollment in advanced CS coursework [23].

D. Progress of the AP CSP course

To date, AP CSP has been successful at broadening participation in CS nationwide. With the launch of AP CSP in the 2016–17 school year—the biggest launch of a new AP course in College Board history—there was a 79% jump in participation in AP CS, with over 100,000 students taking either the pre-existing AP CS A or the new AP CSP exam. In 2019, nearly 100,000 students took the AP CSP exam, more than doubling participation since the course's launch. Furthermore, in its first three years, the number of female students, Latinx students, and Black students taking AP CSP also more than doubled, exceeding the overall course growth [24]. In addition, AP CSP continues to attract a more diverse student population than the AP CS A exam [25].

Closer examination of AP CS exams by gender and by race/ethnicity groups highlight persistent disparities. While participation in AP CS courses continues to grow at a rapid pace, the percentage of female students has only increased from 22% to 29% of exams, and Black students and Latinx students make up only 6% and 17% of students taking AP CS exams, well below the representation of these groups in the wider population [6]. These data suggest that more work is needed to achieve equity, diversity, and inclusion goals. AP CSP can be a critical lever for diversifying CS enrollment in high school and increasing students' likelihood of considering CS-related opportunities in colleges and careers [26, 27]. Yet to realize the full potential of AP CSP, it is vital to pay careful attention to the participation and experiences of students from communities historically underrepresented in computing.

III. Method

A. Study Sample

Our team invited students who were enrolled in an AP CSP course and who attended a NYC high school participating in the NYC CS4All initiative to complete an enrollment survey in the fall of 2019. The resulting sample included 502 students from 22 high schools, covering all five boroughs of NYC. Gender was self-reported by 487 students, with 46.2% identifying as female and 53.8% as male. At least one racial or ethnic group identification was selected by 493 students, with 37.7% selecting Hispanic or Latin American (Latinx), 34.5% Black or African-American (Black), 15.8% Asian or Asian-American (Asian), and 16.2% White or Caucasian (White).[1] Overall, 56 of 493 (or 11.4%) of students selected more than one race.[2] The demographics of our sample were similar to NYC's overall student demographics from the 2019–2020 school year, in which 48.6% identified as female, 51.4% identified as male, 40.6% as Latinx, 24.9% as Black, 16.3% as Asian, and 15.1% as White. In our sample, female students and Latinx students are slightly underrepresented while Black students are overrepresented compared to the overall demographics for the city. Looking at the characteristics of the 22 schools in the sample, we found that they varied in size, student demographics, and geography. Overall, the schools in our sample served a population of students that was largely similar to the overall NYC student demographics. The percent of students reported as in poverty for the overall school sample averaged 72.9%, which is comparable to NYC schools overall at 72.6%. Students in poverty are defined as students from families who have qualified for free or reduced-price lunch or similar benefits.

B. Data collection and analysis

The enrollment survey was initially developed as part of the external evaluation for the BJC4NYC partnership. In addition to demographic questions, the survey asked students about previous CS experiences and their interest in the course. This paper reports on three survey questions related to student interest in taking an AP CSP course: (1) What are your reasons for taking this course? (2) Who influenced your decision to take this course? and (3) What influenced your decision to take this course? For all three questions, students could select more than one response option and could write in an "Other" response. For example, for the question about reasons for taking the course, the response options included choices such as wanting to learn more about CS, the class looks like fun, and preparation for college (see Table I for all response options). The questions—jointly reviewed by the program developers, practitioners, evaluators, researchers, and RPP partners—were reviewed each year prior to administration and revised to increase clarity. These questions were asked in fall of 2019 to inform the development of school and teacher supports for student recruitment. The survey was administered to students online through SurveyMonkey.

Prior to analysis, the write-in responses for each question were reviewed and, if applicable, recoded to one of the given choices or into a new category if enough students wrote in similar responses.[3] Frequencies and percentages were then calculated for each response option for the overall sample, as well as for datasets disaggregated by gender and racial/ethnic subgroups. Based on these percentages, students' reasons and influences were also ranked for each subgroup and compared with the overall sample. Developing these rankings allowed

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[1] Race and ethnicity options also included American Indian or Alaska Native, Middle Eastern, Native Hawaiian or Other Pacific Islander, and Other. However, insufficient sample sizes existed for analysis by these racial and ethnic groups. The same was true for students responding Other or Prefer not to answer when asked about gender identity.

[2] Students who identified as more than one race or ethnicity were counted in all groups which they identified (e.g., a student who selected Black and Asian was counted in both the Black and Asian group analyses). We felt collapsing students' multiple racial and ethnic identities would take away from their self-described racial/ethnic identity.

[3] In total, 94 "other" responses across the three questions were recoded to one of the given choices or placed into a new category. For all three questions, the remaining "other" responses accounted for less than 6% of overall responses. This provides some content validity evidence as to the comprehensiveness of the response options provided in the three questions.

for an additional level of analysis, highlighting differences between subgroups. We further analyzed the responses for reasons and influences by calculating frequencies and percentages for combined gender and racial/ethnic subgroups, e.g., students identifying as female and Black. This additional analysis allowed us to better understand whether the result was more attributable to gender, race/ethnicity, or a combination of both factors. Given the multiple selection response options and modest sample sizes, the differences presented here are descriptive rather than based on statistical tests. Further study with larger samples would provide additional evidence about subgroup differences.

In order to understand possible patterns by schools, frequencies and percentages were also calculated for each response option for all of the schools in our sample. These calculations afforded us the opportunity to see if a disproportionate number of students from any particular school selected or did not select a reason or influence for taking AP CSP as compared to the overall sample.

IV. Findings

In this section, we present key findings from the fall 2019 student enrollment survey. We begin by discussing students' overall responses to the three survey questions that are the focus of this paper, then we look more closely at differences in survey responses when analyzed by gender, race/ethnicity, and intersections of gender and race/ethnicity. Lastly, we discuss a pattern that emerges in the data related to student placement in the AP CSP course that may, in part, be explained by school differences.

A. *Reasons for taking an AP CSP course*

We wanted to investigate students' motivations for enrolling in an introductory CS course, how students' interests varied, and whether there were notable patterns in students' responses when analyzed by gender and racial/ ethnic group. Students were asked to select all applicable responses, and most students selected multiple responses. Ten students wrote in an "other" response; three of these responses were "placed in the course" and were therefore recoded to that option.

Table I provides the percentage of students responding to each of the answer choices ordered from the most to the least frequently selected for the whole sample of students. The table also includes the response percentages by gender (females and males) and by race/ethnicity (Black, Latinx, Asian, and White). Within the table, the percentages of students selecting that response for the three most frequently selected responses in each group are highlighted in gray. In the sample overall, the top three reasons that students selected when asked about their reasons for taking the AP CSP course were: "I'd like to learn more about computer science" (66%), "I'd like to be a better programmer" (42%), and "this class looks like fun" (39%). In addition, roughly a third of students indicated that the course would help prepare them for college, and about a third reported that they were placed in the course. Notably, "I'd like to learn more about computer science" was the most frequently selected reason for students in each of the subgroups included in Table I. Across subgroups, the least frequently selected reason was "I took this class to receive math credit."

TABLE I. Students Selecting Reasons for taking AP CSP

Reasons for taking AP CSP	Overall	Females	Males	Black	Latinx	Asian	White
I'd like to learn more about CS.	66%	62%	70%	54%	64%	74%	85%
I'd like to be a better programmer.	42%	32%	52%	37%	38%	49%	63%
This class looks like fun.	39%	36%	41%	32%	41%	37%	50%
This class will help prepare me for college.	33%	32%	33%	25%	27%	40%	46%
I was placed into this course.	31%	37%	26%	44%	35%	18%	11%
I'd like to learn to create video games.	24%	13%	34%	20%	25%	30%	20%
I would like to make a difference using CS	18%	14%	21%	14%	16%	21%	23%
This is a required class.	16%	21%	11%	24%	18%	12%	1%
I want to major in CS in college.	15%	7%	21%	11%	11%	26%	20%
This is an elective class that looked better than the other elective classes.	11%	11%	10%	9%	12%	10%	18%
I took this class to receive math credit.	5%	6%	4%	5%	8%	5%	0%

Overall, White students and male students selected more reasons from among the eleven response choices than their peers (i.e., they reported more reasons for taking the course than their classmates). On average, White students selected 3.38 responses, with Black students selecting on average 2.7 reasons, Latinx students 2.97 reasons, and Asian students 3.11 reasons. Male students selected 3.28 reasons on average whereas female students selected 2.73 reasons. This results in lower numbers of responses for Black students, Latinx students, and female students for most of the response choices. It may also suggest that for these students the response choices did not relate as well to their experiences.

B. *Influences for taking an AP CSP course*

Students were also asked about who and what influenced their decision to take the course in separate questions. For the "who" question, there were seven answer choices and a write-in option that students could select, and students were asked to select all of the choices that were relevant to their enrollment decision. For "who" influences, 54 students wrote in an "other" response that represented being placed in the course/required course. These responses were analyzed separately and are discussed in a later section.

Table II provides the percentages of students responding to each of the "who" answer choices ordered from the most to the least frequently selected for the whole sample of students. Overall, the most frequently selected "who" influence was the student, as 39% of students chose, "I found this course on my own." The second most frequently selected response at 22%

reflects the influence of friends on students' course enrollment decisions. A guidance counselor recommendation or a discussion with a CS teacher were each selected by 19% and 17% of students respectively. Students in all of the subgroups listed in Table II selected themselves or their friends as an influence among their top three influences. On the other hand, students, both overall and across each of the subgroups analyzed, did not select parents or non-CS teachers as an influence very frequently despite research that parents, guardians, and K–12 educators value CS education [28].

TABLE II. STUDENT RESPONSES FOR WHO INFLUENCED THEM TO TAKE AP CSP

Who Influences	Overall	Females	Males	Black	Latinx	Asian	White
I found this course on my own.	39%	29%	45%	32%	34%	47%	43%
My friends are taking this course or talked with me about this course.	22%	19%	24%	15%	19%	23%	35%
My guidance counselor recommended that I take this course.	19%	22%	16%	27%	19%	14%	6%
A CS teacher talked with me about this course.	17%	18%	16%	13%	16%	26%	15%
Other students talked with me about this course.	12%	12%	11%	9%	10%	10%	29%
My parents talked with me about this course.	7%	6%	7%	6%	4%	10%	11%
A different teacher (not CS) talked with me about this course.	7%	8%	5%	8%	8%	1%	8%

For "what" influenced students to take AP CSP, there were four answer choices with a write-in option and again, students were asked to select all of the choices that were relevant to their course selection decision. Thirty seven "other" responses were placed into a new "interest in CS" category, and accounted for less that 8% of all "what" influences.

Table III provides the percentages of students responding to each of the "what" answer choices ordered from the most to the least frequently selected. The most frequent response was, "I was placed in the course," selected by nearly 50% of the students. Relatedly, almost 20% of students chose "it is a required course." We believe this finding suggests that in some schools, students were "placed" or encouraged to enroll in the AP CSP course. Given that students were asked about placement in and requirements for taking AP CSP as both a reason and an influence, as well as the differences emerging between various populations, these findings will be discussed in further detail in a later section. In addition, about a quarter of students (26%) indicated that they saw recruitment materials for the course and 12% of students indicated that a CS teacher presentation influenced their decision.

TABLE III. STUDENT RESPONSES FOR WHAT INFLUENCED THEM TO TAKE AP CSP

What Influences	Overall	Females	Males	Black	Latinx	Asian	White
I was placed into this course.	49%	51%	45%	61%	53%	36%	19%
I saw some materials that announced the course (like a poster or a flier).	26%	20%	29%	17%	20%	32%	40%
It is a required course.	19%	21%	16%	25%	22%	12%	4%
I went to a presentation by a CS teacher.	12%	8%	15%	8%	9%	15%	19%

C. *Differences by Gender*

Our analysis of the results disaggregated by gender reveal differences between the reasons for enrollment reported by female students as compared to male students. Similar to the overall population of students, the top two reasons male students reported for taking the course were to learn more about CS (70%) and to be a better programmer (52%). In contrast, while the top reason that female students reported was also to learn more about CS (62%), "I was placed in the course" was the second most frequently selected reason for females at 37%. Fig. 1 shows the reasons for taking the course where the percentage differences between male and female students were the largest. While male students taking the class were more likely to indicate specific CS reasons for taking the course (e.g., becoming a better programmer, creating video games), female students more frequently reported that they were placed in the class.

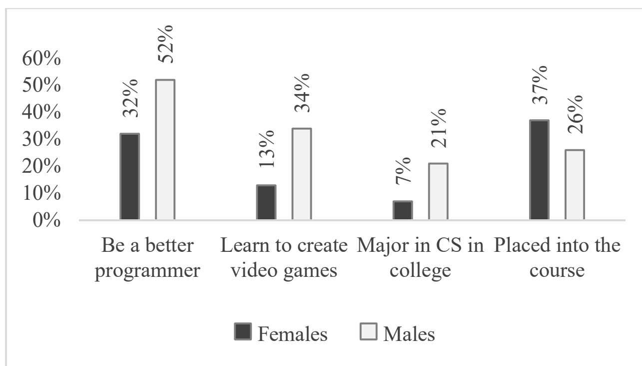

Fig. 1. Largest gender differences in student reasons for taking AP CSP.

Correspondingly, when considering the influences on students' decisions to enroll in the course, our data suggest that external influences may have been more of a factor for female students. While the most frequently selected "who" influence for female students—as well as male students and the overall sample—was "I found this course on my own," a smaller percentage of female students (29%) compared to male students (45%) selected this response. Further, the second most frequently selected "who" influence for female students was a guidance counselor recommendation (22%), whereas "my friends are taking this course or talked with me about this course" was the second ranked "who" influence for male students and for the sample overall. This suggests that female students in our sample may have been encouraged by a guidance counselor to enroll in AP CSP course.

D. *Differences by Race/Ethnicity*

As with gender, there were also notable differences in the frequencies for students' reported reasons when analyzed by racial/ethnic group. Encouragingly, the top reason for taking the course for all racial/ethnic subgroups was to learn more about CS. Similar to female students, the second most frequently selected reason for Black students was that they were "placed in the course" whereas that was the fifth most frequently selected reason for the overall sample. Fig. 2 depicts the differences in frequency of responses for reasons that were the most divergent when analyzed by race/ethnicity. A higher percentage of Asian students and White students selected "to learn more about CS" than Black students or Latinx students. Further, Asian students and White students selected wanting to be a better programmer, preparing for college, and majoring in CS more frequently than Black students or Latinx students.

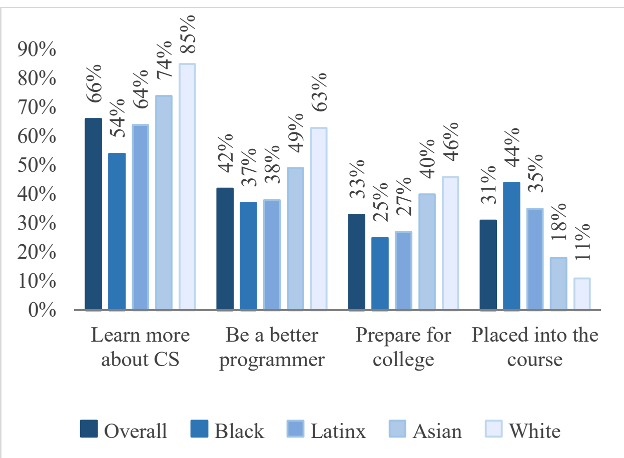

Fig. 2. Differences in student reasons for taking AP CSP course by race or ethnicity.

When considering the influences data, the patterns in the selections made by Black students and Latinx students were close to that of female students. Similar to the findings for female students (22%) in our sample, Black students (27%) selected a guidance counselor recommendation second most frequently as a "who" influence whereas "my friends are taking this course or talked with me about this course" was the second ranked "who" influence for the sample overall. These two selections were each selected by 19% of Latinx students resulting in a tie for second most frequent choice. In comparison, a guidance counselor recommendation was the fourth-ranked "who" influence for Asian students, and seventh-ranked for White students. Notably, Asian students (26%) selected "a CS teacher talked with me about the course" more frequently than any other subgroup. Also, White students (29%) were almost three times more likely to select "other students talked with me about this course" than Asian students (10%), Latinx students (10%), and Black students (9%). In addition, Black students (61%) and Latinx students (53%) more frequently chose "placed in course" as a "what" influence as compared with Asian students (36%), and White students (19%). These data suggest that while all students receive external encouragement to enroll in an AP CSP course, the primary source of this encouragement varies for different subgroups and may reflect the influence of recruitment efforts to diversify CS participation.

E. *Differences by Intersectional Subgroups*

Given the differences in our data for female students, Black students, and Latinx students, we wanted to examine our data for differences when gender and race/ethnicity intersect. Indeed, for Black female students, "placed in the course" was the highest rated reason (53%) for enrolling in the course as compared to wanting to learn more about CS (46%), the highest rated reason for enrollment for the overall sample (66%), for female students (62%), and for every racial/ethnic subgroup of students that we examined. While females selected "wanting to become a better programmer" less frequently than males, Latinx females (23%) were the only subgroup where this was not one of the top three reasons.

Even stronger patterns emerged when looking at the percentages of students in each intersectional subgroup reporting "placed in course" either as a reason for enrollment or in response to "what" influenced them to take the course. 76% of male students and 88% of female students who chose "placed in the course" as a reason for enrollment were Black and Latinx. "Placed in the course" was selected as a "what" influence far more frequently by Black female students (64%), Latinx female students (63%), Black male students (61%), and Latinx male students (45%) as compared to Asian female students (32%), Asian male students (38%), White female students (17%), and White male students (20%).

Table IV shows the percentages of each intersectional subgroup selecting "placed in course" as a reason and "placed in course" as an influence. Students were more likely to indicate that they were "placed into the course" when responding to the "what" influences question than the reasons for enrollment question, and we believe that is because there were more reasons offered and other options may have been more primary for students; the overall trends are relatively consistent.

TABLE IV. STUDENT RESPONSES FOR COURSE PLACEMENT

Race/Ethnicity	**I was placed into this course.**		
	Gender Identity	***Reason***	***Influence***
Black	Female (n=91) Male (n=76)	53% (n=48) 34% (n=26)	64% (n=58) 61% (n=46)
Latinx	Female (n=86) Male (n=96)	44% (n=38) 26% (n=25)	63% (n=54) 45% (n=43)
Asian	Female (n=28) Male (n=50)	14% (n=4) 20% (n=10)	32% (n=9) 38% (n=19)
White	Female (n=36) Male (n=44)	11% (n=4) 11% (n=5)	17% (n=6) 20% (n=9)

The data for students selecting that the course was required as a "what" influence or as a reason for enrollment suggest a related pattern. Table V depicts the frequencies and percentages of students for each intersectional subgroup that indicated that the course was required, either as a reason or as a "what" influence. When looking specifically at required course as a "what" influence, greater percentages of Black male students (29%), Asian female students (29%), Latinx female students (26%), and Black female students (22%) indicated that they took the course because it was required as compared to their White female (6%), Asian male (2%), and White male (2%) peers. Similar percentages were reported when we looked at the responses for "this was a required course" as a reason for course enrollment.

TABLE V. STUDENT RESPONSES FOR COURSE REQUIREMENT

Race/Ethnicity	**I was required to take this course.**		
	Gender Identity	***Reason***	***Influence***
Black	Female (n=91) Male (n=76)	24% (n=22) 25% (n=19)	22% (n=20) 29% (n=22)
Latinx	Female (n=86) Male (n=96)	27% (n=23) 9% (n=9)	26% (n=22) 18% (n=17)
Asian	Female (n=28) Male (n=50)	21% (n=6) 6% (n=3)	29% (n=8) 2% (n=1)
White	Female (n=36) Male (n=44)	3% (n=1) 0% (n=0)	6% (n=2) 2% (n=1)

In addition, Black female students and Latinx female students were the only intersectional subgroups indicating that the top "who" influence was the guidance counselor (30% and 24% respectively). While not their top influence, our findings suggest that a guidance counselor may also play an important role for Black male students (25%). For all other intersectional subgroups that option was selected by less than 15%. Similar to the findings from our data disaggregated by gender and by race/ethnicity separately, these intersectional group analyses suggest that external influences—more so than finding the course on their own—may play a greater role particularly for female students, Black students, and Latinx students. This may reflect the influence of school and CS4All efforts aimed at increasing diversity in CS participation and suggest future directions for recruitment efforts.

F. Course placement and course requirement

As mentioned above, we found an interesting pattern with placement in the course and the course being required as key reasons and influences identified for students' AP CSP enrollment decision. Students expressed the perception that they were placed in the class or taking the course because it was required in multiple places on the survey, including as a reason for taking the class and "what" influenced their decision to take the course. While it may seem repetitive to include these factors in multiple locations, we felt they could be viewed as both reasons and influences for enrolling in the course. Further, when asked about "who" influenced their decision, 54 students even wrote in the "other" response box that they were placed in or required to take the course, providing additional evidence of the importance of these factors to students. Of these 54 students, 47 students identified as Black or Latinx, and 29 as female students.

As the data in Tables I and III above show, female students reported "placed in the course" and "required course" more frequently than their male peers. Similarly, Black students and Latinx students reported "placed in the course" and "required course" more frequently than the Asian students and White students in our sample. Similar patterns held in the analysis of our data by intersectional groups.

Given the prevalence of this pattern in our data, we examined differences in our data by school. We found that in 10 of the 22 schools in our sample, more than half of their AP CSP students said that they were either placed in the course as a "what" influence or selected it as a reason for their course enrollment decision. When comparing the responses for these 10 schools, 49%–89% of students identified "placed in the course" as a reason for taking AP CSP as compared to 0–25% for the remaining sample schools. Similarly, 63–100% of students from these 10 schools selected the response "placed in the course" as a "what" influence compared to 0–33% for the remaining 12 schools in the sample. Demographically, these 10 schools were on average smaller (539 students on average compared to 618 in the overall sample) and served more students in poverty (80.4% on average), with a greater proportion of Black students and Latinx students (40.2% Black, 44.6% Latinx, 7.7% Asian, and 4.7% White on average) when compared to the larger sample of 22 schools.

Given the relative concentration of students reporting that they were "placed in the course" or that it was a "required course" within this subsample of schools, we examined whether there were differences in school policies, recruitment strategies, or context that might contribute to this pattern. During the 2019–2020 school year, there was not a system-wide requirement in NYC for a high school CS course as a graduation requirement so teachers in our sample were asked via email if particular students were placed in or required to take AP CSP classes at their school. From the teacher responses received (59.1% response rate overall and 50% response rate for subsample), we learned that in most schools AP CSP was not a required course and, generally, students chose to take the course. We also heard that students may be encouraged to enroll in AP CSP, and while the course was not required, some students were placed in the course to help fulfill a mathematics or science credit that students needed for graduation, so that there were enough students to hold the class, or because there were limited elective course options. In discussing these school differences within the RPP, these practices were consistent with their knowledge of and experiences in NYC high schools. It was interesting that schools with higher percentages of students indicating a guidance counselor influence were all in the 10-school subsample. This spoke to the role that teachers, administrators, and guidance counselors play in encouraging and recommending course options for particular students.

In summary, these data suggest that the enrollment of Black students, Latinx students, and female students in AP CSP may reflect greater influence from guidance counselors and teachers in addition to their personal interest. Still, wanting to learn more about CS was the highest rated reason for enrollment in the overall sample (66%), for female students (62%), and for each racial/ethnic group of students but not all intersectional subgroups. These patterns may also be explained by the efforts of the NYCDOE CS4All initiative working with schools to attract more female students, Black students, and Latinx students to participate in CS courses.

V. Implications

By investigating students' reasons for enrolling in AP CSP and exploring the influences on students' decisions, we learned that high school students are expressing strong interest in learning more about CS and many are seeking out AP CSP. Consistent with nationwide CS enrollment trends, enrollment numbers from NYC indicate that the efforts of the NYCDOE CS Education Team and its CS4All initiative are encouraging female students, Black students, and Latinx students to enroll in AP CSP in increasing numbers. Our findings indicate that this may in part be due to the role of guidance counselors, as they appeared to be important in raising awareness of CS learning opportunities for female students, Black students, and Latinx students in our sample. There were commonalities in students' reasons and influences for enrolling in AP CSP, but we also found variation by gender and by race/ethnicity. These variations suggested that for some students, particularly those who identified as Black, Latinx, or female, that interest in the course may be influenced by external sources, and students may perceive that they were placed in the course or required to take AP CSP. These findings raised questions about how students identify with and engage in CS and how recruitment strategies can support greater access and participation, questions that we continue to pursue within our RPP.

There is a desire in our RPP to better understand student participation and success in CS, and disparities by gender and by race/ethnicity. Our RPP practice partners were particularly interested in learning more about factors influencing student enrollment in AP CSP as they were aware that students who have access and exposure to CS tend to be more interested in and more likely to see themselves in CS. Further, they felt these results could be used to support school leaders in aligning and integrating CS education and equity activities more strongly with schools' broader goals and improvement plans, and could inform the NYCDOE CS Education Team regarding supports to provide more equitable CS instruction. When interpreting these results together, of particular interest to our partners were the findings related to student placement in AP CSP including that the schools receiving CS4All support where proportionally higher numbers of students selected "placed in course" were serving higher proportions of students of color and students in poverty, thus increasing access to and enrollment in CS classes for historically underserved students. Our partners wondered whether students who reported that they were placed in or required to take the course may not yet feel like they belong in a CS course, and therefore, it may be particularly vital to consider ways to broaden those students' perspectives of CS and to address students' perceptions of belonging and identity in CS because these are critical to students' further interest in CS.

The results also prompted thinking about the engagement of school administrators, teachers, and other school leaders, and how to empower such leaders with guidance and tools (e.g., recruitment resources) that promote equity in CS. These findings have already contributed to the NYCDOE CS Education Team's planning in the recruitment of schools to the CS4All initiative's programs as well as student recruitment within schools. Specifically, a set of infographics were created and disseminated from these findings to be used as student recruitment resources. Furthermore, our findings on the influence of counselors in encouraging students to take AP CSP may reflect the CS4All initiative's efforts to build school culture with multiple stakeholders in the school community working together to increase equitable CS implementation. Our findings suggest there could be even greater involvement of counselors in school CS teams working alongside teachers and principals, and more specific guidance and supports could be provided to school counselors and parent coordinators.

In addition, these findings also raised questions for further inquiry and future research. The differences that we found in students' reasons for selecting CS suggest that social barriers (e.g., perceptions of CS and who does it) persist for female students, Black students, and Latinx students but additional research is needed to understand how that may relate to students' sense of identity and belonging in CS. Prior research points to the connection between a sense of belonging and maintaining interest and persistence in CS, and suggests the need for further study of the experiences and supports that increase students' interest and perceptions that they belong in CS courses and careers. The findings may raise questions about whether a CS requirement could play a role in developing student interest and create opportunities for students to develop their CS identity and sense of belonging. In addition, some may question whether interest development is a good focus for broadening participation in CS. The study's finding of student interest in learning about CS as the primary reason for AP CSP enrollment suggest the importance of exposing students to CS earlier in the K–12 grades to expand awareness of what CS is and who engages in CS. Indeed, CS4All efforts in NYC such as involvement in CS Education Week, development of school CS culture, and the integration of CS into other classes in the elementary and middle grades serve to broaden student understanding of and perspectives about CS. The initiative believes that engagement with CS learning opportunities will ultimately increase student interest and sense of belonging in CS. Moreover, this work suggests the need for future research to examine relationships between students' reasons for enrollment and their outcomes, including whether students persist in taking and passing the AP CSP course and exam, and their attitudes and perceptions of CS as well as their interests in pursuing further CS education.

VI. Limitations

Limitations to the results shared here include that beyond the data we collected from AP CSP teachers, there may be other school policies or conditions that affected student placement that we may not be aware of and may affect our interpretations of the course placement and requirement data.

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