Inclusive and Scalable Study Group Formation

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by

Gloria Tumushabe

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Abstract

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Peer collaboration is essential for learning because it creates positive experiences in the classroom and makes students feel supported. While many researchers have attempted to make the teamwork experience better for students, women and students from racially marginalized communities sometimes still feel excluded in-class study groups. Even worse, some are even unable to find study groups at all. This project seeks to make finding a study group easier for the students and the study groups are created to be more inclusive.

We conducted an experiment on study group formation in an introductory Electrical Engineering and Computer Science course, Designing Information Devices and System's I using a lightweight, automated, scalable and inclusive approach. Our project aims to make the burden placed on students who want to find study groups very minimal. To form the groups, we created surveys to collect demographic information and team matching details using google forms. These steps not only enabled us to form more effective groups but also allowed us to investigate the experiences of these students. Using an automated software platform, groups were generated while ensuring that there was no single person from one demographic category that was in a group by themselves. The students were then given study guidelines to follow during interactions with their group members. Students were allowed to request for reassignment after two weeks in the case that they were unable to connect with their group members or for any other reason where they felt the need to find a new group. To examine the impact of our approach to forming the groups and to understand the experiences of the students in the groups, we administered surveys at the middle and the end of the semester.

In this report, we present the process of forming the inclusive study groups and the key findings such as the similarities and differences in the comfort levels and future study group plans of the students from different demographic groups. We also present the effects of participation and interaction frequency of the students in the study groups. Finally, we highlight some reflections from this project and propose strategies to improve the existing group formation strategy.

Contents

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Chapter 1

Introduction

1.1 Motivation

Interest in computer science and electrical engineering is growing. With this growing interest in computer science, increasingly more students are enrolled in university introductory engineering and computer science courses. The introductory classes teach fundamentals and introduce students to very important building blocks for the subject so understanding and enjoying these classes with peer support is crucial to students' belonging [1]. However, the computer science and electrical engineering field does not have adequate representation for women and Black students [2].

One of the reasons for the inadequate representation of women and Black students is students feeling a lack of belonging in the field [1]. The author of this project report experienced a lack of belonging due to the inability to find study partners in some of the classes and due to arbitrarily formed study groups which ended up being more harmful than helpful. This became a source of motivation to support undergraduate students to find avenues for belonging in this field.

Supporting students to form friendships and supportive peer study groups at the beginning of their undergraduate careers is important for enhancing their sense of belonging. These friendships are essential for career growth, academic support, and emotional support throughout the entire undergraduate journey and beyond [1].

One way to support students to develop friendships and enhance their sense of belonging is through collaborative study groups. In situations when students join the university and have no community or friends within the same program or class year, facilitating collaboration is important in helping the students form a community. Collaboration has been shown to nurture social development by enabling better attitudes toward school, increased appreciation of cultural, and racial diversity and appreciation of school and their peers [3]. Along with a team to complete assignments with, learning in a community provides emotional support which is essential in getting through difficult courses [4]. When students work together, they absorb the material better [4] and they are more likely to stay in the major compared

to students who feel alone and isolated while navigating their classes [5].

Collaboration is also a skill that is valued at workplaces, and this research aims to build the skills early on in their undergraduate study. Some companies have reported that new graduates lack collaborative skills [6]. Lack of group work skills in these new graduates affects their future career development.

Despite the many benefits of collaboration, students could very easily feel excluded within study groups [7, 8]. For this reason, this research proposes a thoughtful study group formation design process after interviewing some stakeholders. Our research highlights a lightweight, automated, scalable, and inclusive approach for forming study groups. We collect demographic and location information using google forms and we use a software platform to form the groups while ensuring that no single student from a particular demographic is a singleton in a particular group. We provide study group guidelines for the students to follow while running their group meetings to ensure that there is fairness and respect in the groups.

A key emphasis in the design of the study groups was creating psychological safety and comfort for all the students. After looking at work done in building successful teams by Google [9], we learned that Project Aristotle concluded that "what distinguished the "good" teams from the dysfunctional groups was how teammates treated one another. The right norms, in other words, could raise a group's collective intelligence, whereas the wrong norms could hobble a team even if, individually, all the members were exceptionally bright" [9]. From the Aristotle project, the important norms included equality in conversational turn-taking and high average social sensitivity [9]. We emphasized getting to know team members and how that changes the way communication happens. According to the researchers in the Aristotle project, the most important value in a team is psychological safety [9]. The researchers refer to team members feeling safe to take risks and be vulnerable with each other as psychological safety. Another paper highlighted these norms and stated that these two norms are aspects of psychological safety: a sense of confidence that the team will not reject or punish someone for speaking up [10].

Our deliberate group formation approach highlighted in chapter 2 enforces psychological safety and minimizes not only student exclusion but also the consequences associated with feeling alone in a team hence avoiding tokenism, improving retention in the program, and promoting leadership and confidence of the students as shown by the key results of this project in chapter 3. Our group matching project tries to balance heterogeneity and homogeneity by finding similarities between the students based on students' time zones and year groups while ensuring that there is no singleton from a specific demographic category in the groups.

This project draws inspiration from the work done by previous researchers on collaboration, further described in the next section 1.2.

1.2 Previous work on group formation

To be able to form inclusive study groups that give students a chance to learn concepts while being respectful and welcoming, this work builds on previous work done on collaboration and group formation. Different group formation styles have been explored by researchers including groupings based on mastery of the topics, groupings based on learning style, groupings based on a combination of mastery and learning styles, groupings that enable pair programming techniques, and groupings using a software platform. Different grouping techniques aim to achieve functional groups that vary in terms of both duration and purpose.

Grouping based on mastery of topics and learning styles

The latent jigsaw method creates a peer-learning situation in which a topic has been split up and each part mastered by a student in a group [11]. This method creates a peer-teaching environment that promotes productivity and requires uniform participation by all group members [11]. Another common strategy used in business management for forming teams is to use personality types and learning styles [12]. Grouping using learning styles takes into account personality types to form groups that promote participation and productivity by creating a socially comfortable atmosphere [11].

Diebel performed grouping research using the latent jigsaw method [11]. Diebel suggests that team interaction increases when instructors help with selecting the teams [11]. She also mentions that teamwork is important because it enables students to absorb the material better and it encourages cognitive growth [4]. As one of her group formation strategies, Diebel uses the latent jigsaw method, a modification of the jigsaw method (a cooperative learning strategy that enables each student of a group to specialize in one aspect of a topic, and another group to specialize in another topic) originally developed by Clarke [13]. In Diebel's adjusted method, students formed expert groups in which each group already had mastery over a topic. After some time, these groups were reshuffled to have members from each expert group represented in the mixed-expertise groups to explain the concepts to each other [11]. This method of collaboration is mainly tailored for short-term collaboration in classes and understanding exercises in the classroom. According to the observation from pairing students using the latent jigsaw method, most of the students improved their socialization and some reported that their opinions on what they thought was correct had changed [11].

Diebel also created groupings using learning styles [11] by drawing inspiration from groupings created using the Felder-Silverman learning styles [12]. Different students learn differently. Active learners brainstorm and talk as they go through the prompt, reflective learners take their time and think in silence before coming up with ideas [11]. Global learners are also different from sequential learners because the former often first grasp the big picture and then adds in the details while the latter typically acquires information in small, ordered chunks to form the big picture [11]. In Diebel's work [11], students with the same learning style are put in the same group and after some time, they are mixed up to have a discus-

sion [11]. By the end of the collaboration process, there was an increased appreciation for collaboration [11].

Similar to [11], our group matching project believes that instructors should facilitate the group formation process by ensuring that the matching is not done by students. Unlike our project, the methods used by Diebel [11] are meant to encourage in-class, short-term group work and not promote long-lasting collaborations among the students. Our group matching project gave students the option to opt-in or out and control their scheduling which varied with Diebel's [11] approach of having the whole class participate in the chosen group formation process. The group matching project that we deployed also gave students a chance to ask for a re-assignment in case the groups were not working out for them, hence giving students more flexibility within the group formation framework. Unlike Diebel [11], we did not physically observe the students' interaction given the large number of students in the class. To analyze the student's experiences, we collect survey data and use an automated software to form the groups hence making our project scalable for larger classes and remote settings.

Grouping based on students' programming skills

Similar to the latent jigsaw method highlighted in the section above 1.2, the key idea behind this group formation method was to create groups of students who have different responses to the same problem and want to achieve a joint solution.

A group of researchers at different universities in Brazil conducted a study to understand how to form groups for collaborative learning of the Introductory Computer Programming course based on the students' programming skills during the class [14]. They used a tool called the Program Quality Assessment System (PQAS). The PQAS tool creates groups to produce social-cognitive conflicts. "The socio-cognitive conflict theory is when individuals have different responses to the same problem and are motivated to achieve a joint solution" [14]. PQAS computes a Global Index of Quality (GIQ) score to assess the program quality by looking at some metrics and a report is generated. This report was used to form six groups. The collaboration took place during lab classes. In the groups, the members of each group were asked to exchange their programs and reports to try and find the reported anomalies in their colleagues' programs [14]. Then, each student discussed with their group-mates the likely sources of the anomalies in the examined program and how to improve it. Afterward, a group leader, randomly chosen and previously oriented by the instructor mediated the collaboration within their group colleagues conducted to develop a group version of the program. The new program was also submitted to PQAS. A new report was generated and presented to the students. They were asked to compare and contrast the program they produced individually with the program produced by the group [14]. Students were also asked to comment on the differences between their programs and the group program. Students with low scores benefited the most from the groups because their scores improved greatly [14].

Similar to our group matching project, the groups formed using PQAS were encouraged to work individually at first and then go ahead and work on the assignment in groups. The groups formed with PQAS also use a facilitator to lead the discussion. However, our groups have study guidelines to encourage the students to rotate roles during meetings to allow each student to get a chance to be a facilitator.

Grouping based on students' programming skills merged with learning styles

Naturally, one is curious about the impact of a joint mastery-based and learning-style based grouping. The researchers who worked on collaboration based on programming skills referenced in 1.2 [14] used another tool called GroupOrganizer to consider not only the programming skills of the students but also the learning abilities of the students in forming the groups [14].

GroupOrganizer considers learning abilities of the students through the Learning Style Inventory (LSI). LSI identifies students' learning styles by defining the way people learn or prefer to learn [15]. The goal of the system is to group students with the same styles or complementary styles in an attempt to avoid undesirable conflicts, which usually occur because of incompatible learning types within a group [14]. The learning styles used in the groupings are *convergent* style (characterizes students who make decisions quickly and learn by trial and error), the *divergent* style (characterizes students who can generate alternatives and analyze situations from many perspectives), the *assimilator* style (characterizes students who have excellent inductive reasoning and ability to create abstract models, but need time to reflect and the *accomodator* style (characterizes students who are good at carrying out plans and experiments and who involve themselves in new experiences) [14]. Regarding how the different groups work together, "exact opposites have special synergies when their differences complement, they become antagonists when differences conflict" [16]. The students first worked on the assignments individually to get their GIQ and then they were matched to ensure that the groups had students with heterogeneous GIQ. The three groups had specified the learning styles. Group one had students with the same learning styles, group 2 had at least one student with a different non-complementary style and group 3 had students with the same or complementary learning styles. After working in groups, the students completed individual assignments to see if working in the different learning styles caused an improvement in their GIQ [14].

According to [14], there was an improvement in many students programming styles. The instructor observed that interpersonal communication was more difficult in heterogeneous groups and in the homogeneous group formed by divergers [14]. As expected, higher learning gains were verified in the group with the same learning styles [14]. Collaboration was more spontaneous in homogeneous groups [14]. Additionally in heterogeneous groups, stronger students (with high GIQ) tended to try to impose their positions to weaker students (with low GIQ) when the instructor was not present [14].

Our group matching project draws inspiration from [14] by using surveys to collect the student responses in order to form the groups. Our implementation also focuses on using a software to form the groups and we make sure that every interested student has a group. One key difference is that our project does not consider the performance of the students when matching them using the automated software. Neither the performance nor the learning styles are considered when forming our groups. Our group matching project also collects students' feedback rather than watching them work together given the remote nature of the classes. This is a more scalable way of analyzing the way groups work for large classes and for students who collaborate remotely.

Grouping using pair programming

Pair programming is a setting in which two students work together on the same computer. The student who is in control of the mouse and keyboard is called the "driver" while the student responsible for guiding the driver and giving instructions or advice is called the "navigator" [17].

Shah et al. portray the fact that equal access to material resources in a classroom is as important as access to non-material resources in student learning [17]. The authors show the importance of collaboration in the classroom through using pair programming and facilitating collaboration to enable the students to collaborate correctly. They also mention the importance of collaboration in keeping students engaged in the learning process, and they emphasize that students who are positioned as "low-status" could disengage from the learning process if they do not have peer support [17]. Students who do not perceive themselves as capable of academic success are less likely to persist in learning [17]. In this work, the team of seven researchers collaborated to design and implement plans for equitable instruction in a course during the summer of 2012. Through the course, the instructors encouraged the students to work together. Each day the students alternated between working through the online curriculum individually and working with a partner. On "solo programming" days, although students worked on their own computers, they were still assigned a partner who they were encouraged to turn to for help. On days that students worked with other students, they did pair programming, in which students are paired in groups of two (occasionally groups of three) while working together on one computer [18]. To make sure the collaboration was done successfully, the instructors made it a point to give clear instructions about pair programming and they also demonstrated what a healthy collaboration looked like. They also made sure students gave each other the chance to be a driver in the pair programming exercises. To enable students to interact with each other, the instructors made sure to get students to sit in different locations in class so that they could meet new students.

Similar to [17], our group matching project has study guidelines so that students know how to interact and what a healthy collaboration looks like. In stating the collaboration guidelines, we mention important factors like rotating roles and allowing other students to speak. This is further highlighted in the pair programming research [17] since the instructors spend time showing the students what proper and positive collaboration looks like. A major

difference between our group matching project and the research done on pair programming is the fact that we do not switch around the pairs/groups unless the students ask for reassignment. Our groups do not work under supervision and the instructors do not physically observe the groups interacting.

Grouping using an automated software

This method involves forming groups using a software based on the lab sections and the students' schedules.

Wills et al. method of grouping is done using certain parameters such as laboratory sections and out-of-class schedules [19]. The authors then gather basic student information along with scheduling information and students' backgrounds coming into the course [19]. Once the student information is stored, another program automatically groups students based on priorities given to various parameters [19]. The authors use the laboratory section and out-of-class schedules as the first two criteria [19]. With this program, they have the capability to generate new groups based on new parameters if desired [19]. In this method of grouping, one member records the group membership and results and then turns in the work at the end of the class [19]. This approach allows the faculty member to easily review all, or a sampling, of the work submitted, as well as give participation credit to all students in the activity during the class group exercises [19]

The results of this work are not shown in the paper as the class was still ongoing when the paper was published [19], but it is similar to our project because an automated software is used to form the groups.

However, unlike the work done by [19], our students were supposed to turn in the homework individually and list the group members. This encourages students to write down their own solutions and use the groups for collaborative discussion. In our groups, the students form their own schedules and collaborative platforms for their groups after being matched by the software. We rely on using a software platform to automate matching based on different priorities such as timezone and class year. Our work is novel because we ensure that no one student from a single demographic category is in a group by themselves.

Conclusion on previous work done on study group formation

In summary, researchers have tried different types of grouping such as mastery-based, learning-based, a merge of mastery and learning-based styles, pair programming, and grouping with an automated software platform. Although great results have been observed from different grouping techniques, our work aims to create inclusive groups by taking into account demographic information while using a software that automates group formation. The next section highlights the steps taken to form the groups that ensured that there were no singletons from a specific demographic category in the groups formed.

Chapter 2

Project design

This chapter entails the design process to form the study groups and we highlight the steps to achieve inclusive study groups. Firstly, we explain the informational interviews and the reasons behind conducting interviews with some of the stakeholders. Secondly, we highlight the factors behind designing groups that avoided having a singleton from a specific demographic category, and we back up the reasons using academic literature and research done on these topics. Thirdly, we describe the survey and study guidelines design. Finally, we present a summary of our design outline for the groups that we formed.

2.1 Informational interviews and personal experience

As part of the planning process, we conducted informal chats with 6 students in different student groups such as the Black Engineers and Science Students Organization (BESSA), the Society of Women Engineers (SWE), Computer Science Scholars, the Hispanic Students Society (HES) and the Transfer Students Pre-Engineering Program (TPREP). We also met with the Director of Student Diversity of the Electrical Engineering and Computer Science (EECS) Department to discuss what makes students feel more comfortable in study groups. The first key goal of the interviews was to understand the students' unmet needs in the study groups to help us figure out what important key factors would be added to this project to make collaborative learning a good experience for them and others. From the six underrepresented students that we spoke to, we learned that finding study groups can be extremely difficult and sometimes students choose to work alone to avoid going through this difficult experience.

- A Black male student mentioned that the biggest challenge is being in a classroom where many students already have connections with each other and trying to figure out people to work with. This can be an overwhelming experience, especially in a large class.

- Two female Hispanic students mentioned that finding study groups is not difficult but having a functional study group can be challenging. One of them highlighted that "it is easy to meet some people in office hours who are seeking help and ask to work with them. However, scheduling meeting times might be hard after that."

- A Black female student mentioned that the conduct of team members makes it hard to work with some students. "Too many micro-aggressions and hence the need to work alone after that." This student narrated her experience that showed that study groups formed randomly in a class section could end up hurting the students if they lack proper guidelines on how to collaborate.

- A female Indian student mentioned that being in majority male study groups makes it hard for her to speak up because the men constantly try to take credit for everything she says. She mentioned that it had been hard for her to find majority female study groups given the low numbers of women in the Computer Science department.

- The Director of Student Diversity emphasized what most of the students said. Through speaking with the Office of Student Diversity in EECS, we learned that many students need their peers for support in not only classes but also to enjoy learning the material. Study groups can also influence post-graduation decisions, such as going to graduate school. We also learned that students who do not feel isolated enjoy their time at Berkeley a lot more than students who feel alone.

The author's experience aligns closely with the students because she struggled to find study groups or often found herself in randomly formed groups in which she was the only person from her demographic category. This experience and the other students' experiences emphasized the need for more inclusive and well-thought-out groups.

The second key goal of the interviews was to go through some of the survey questions and make sure that the underrepresented students felt comfortable being asked these questions for the purposes of grouping them. The students thought our survey questions were fine and they appreciated that we divided the surveys into a demographics survey and a group matching survey. One student mentioned that it was great that we recognized that there are many different people and planned to consider some of these differences when making sure that students were paired up and did not feel isolated.

Thirdly, the interviews enabled us to generate study guidelines that were meant to enable students to learn how to work together and create an inclusive working environment for everyone. Through brainstorming, we were able to uncover the importance of equal contribution in the study group and, therefore, the need to structure our guidelines in a way that allowed every student to contribute to the collaborative learning process. We also further understood the importance of having an initial meeting to encourage people to get to know each other ahead of working together to make the collaboration experience even better.

2.2 Background work for group design

The group formation ensured that no student was a singleton from a demographic group in the study group formed. Our reasons for designing the study groups this way are below.

Ensuring retention in the course

Individuals experience solo status when they are the only members of their social category (e.g., gender or race) present in an otherwise homogeneous group. Field studies and surveys indicate that members of socially disadvantaged groups, such as women and racial minorities, have more negative experiences as solos than members of privileged groups, such as Whites and males [20]. In a paper titled *When Being Different Is Detrimental: Solo Status and the Performance of Women and Racial Minorities* [8], the authors emphasize that solo status can lead to lower public performance; that is when one is asked to demonstrate one's knowledge or skills under the scrutiny of others. The authors of [8] mention that public performance of women and African-Americans is more debilitated by solo status than that of Whites and males. The authors of [8] further discuss how findings from social psychology research can be applied towards the goal of reducing the detriments typically associated with being the only member, or one of few members, of one's race and/or gender in the environment [8]. One of those detriments being lower performance, which leads to dropping out.

Creating favorable conditions for women in a department is necessary to ensure retention [21]. Without adequate peer support, women are more likely than men to leave computing programs. When a department's gender composition is unbalanced, women have less access to support from women classmates [21]. Another paper that recommends strategies to retain women in undergraduate computing highlights that creating a sense of community can be facilitated through collaborative learning in classrooms [22].

Research done at the University of Massachusetts, Amherst found that early in college, young women in engineering majors felt more confident about their ability, a greater sense of belonging in engineering, more motivated and less anxious if they had a female, but not male, peer mentor [23]. In this research, the results show a need for female-to-female peer mentorship and support. At the end of the first year of college, a remarkable 100 percent of female students mentored by advanced female peers were still in engineering majors. This compares with an 18 percent dropout rate for women students with male mentors and 11 percent for women with no mentors [23]. The need for women supporting other women is paramount, and our study group matching project achieves this by trying to ensure that there is not just one woman in a team.

Several women involved in a research study about improving the persistence of first-year undergraduate women in computer science appreciated all women support groups because they provided opportunities to discuss academic and social issues concerning the major [24]. This is one way of creating a community and making sure the women do not feel isolated and choose to stay in the major.

Promoting leadership and confidence of the students in the team

In a paper titled *Making Computer Science Minority Friendly* [25], the authors believe that anxiety in the classroom can be mitigated to some extent by feelings of interpersonal familiarity and acceptance by peers. The authors mention that "Students feel more comfortable if they interact more with peers who are similar to them." The high levels of anxiety in the classroom can be detrimental because anxiety is associated with low self-esteem [26] and therefore low confidence.

Being a lone woman of color in a team is detrimental because it causes people to change themselves to adapt to the dominant culture. In an article about *"How Black Women Describe Navigating Race and Gender in the Workplace"* [27], interviews with 10 women of color shed light on some of the common challenges faced by black women in the workplace, how they cope with those challenges, and how those coping mechanisms affect their chances of long-term success. Many of the women talked about having to code-switch or embrace the dominant culture at work. Another pattern was what one of the women called "dimming my light," or dampening aspects of their personality to avoid making colleagues uncomfortable [27].

A Swedish research team found that women who were randomly assigned to male majority teams were less willing to become team leaders than women assigned to female majority teams [28]. In this study, it was found that male majority teams led to a negative effect on women's leadership aspirations and therefore a negatively affected their confidence, influence, and expected support from team members. The study involved 580 participants (283 women and 297 men). In this study, the participants had to first solve a task individually and then they were put in either female-majority or male majority teams [28]. When they were asked to rank their willingness to lead teams, a substantial and significant gender gap in willingness to lead was discovered [28]. On average, women's willingness to become the team leader is 0.56 standard deviations lower than men's [28]. On average, the stated willingness to lead among women in male-majority teams is 0.46 standard deviations lower than that among women in female-majority teams ($p < 0.001$) [28]. Thus, the researchers found evidence that women are less willing to lead male-majority teams when compared to female-majority ones [28].

This is one of the factors we considered in avoiding singletons because we did not want women lacking the confidence to take on leadership roles within the groups.

Avoiding tokenism

Another factor behind designing the groups in a way that avoided having one student from a particular demographic in a study group was to avoid tokenism. Tokenism is defined as the practice of making only a perfunctory or symbolic effort to be inclusive to members of minority groups, especially by recruiting people from underrepresented groups in order to give the appearance of racial or sexual equality within a workforce [29].

In research done to investigate whether token women are disadvantaged compared to women on majority-women or mixed-gender teams, researchers conducted a multi-year field experiment with a top ten undergraduate accounting program that randomized the gender composition of semester-long teams. The program enrolled 535 students (384 men and 151 women) in the fall semesters of 2016 and 2017. Women comprised only about 28 percent of the overall enrollment in the program. Historically the program responded to this imbalance by placing one or two female students per group. It was found that these token women (lone women in the group) were seen as less influential by their peers and were less likely to be chosen to represent the group than women on majority-women teams. Token women also participated slightly less in group discussions and received less credit when they did as highlighted by the surveys filled in the program [30].

Preventing women and students from racially marginalized communities from feeling like tokens is good for their mental health [31]. According to [31], tokenism is stressful because the burdens carried by tokens in the management of social relationships can cause psychological stress, even if the token succeeds in work performance. Tokenism leads to unsatisfactory social relationships, miserable self-imagery, frustrations from contradictory demands, inhibition of self-expression, feelings of inadequacy, and self-hatred [31].

A 1978 study by Eve Spangler and her colleagues shows some effects of tokenism. They conducted research on female law students, examining the effect of gender ratios on women's achievement [32]. They used data from two law schools, one with a 33 percent women student body (School A) and the other with 20 percent women (School B). Spangler and her colleagues measured three hypothesized consequences of tokenism: performance pressure, social isolation, and role entrapment. They concluded that women in School B (the more skewed demographic) felt more performance pressure than those in School A. The women's grades were lower than their male peers, the women in School B spoke in class less than the men, and the women in School B gave more thought to quitting than did their male counterparts [32].

A piece written about how being the only black person in a group [33] involves emotional labor because it causes students to feel like a token also informs our decision to design our groups such that not a single student from a demographic category is in a group alone. In this piece [33], the authors state that when there is one student from an underrepresented group in a team, they are likely to feel like a token. More research showed that tokens have higher levels of depression and stress [33]. Tokens are more likely to experience discrimination and sexual harassment than women and racial minorities who are working in more balanced environments [33]. Additional research also shows people are less satisfied and less committed at their jobs if they're tokens [34].

In summary, we wanted to make sure that students felt like they belonged by ensuring that no single student from a particular demographic was alone in the group. Using the demographic and group matching surveys which are highlighted in the next section 2.3, an automated software matching system was used to match students.

2.3 Survey design

We designed four surveys and one optional **reassignment survey**. Our first survey was a **demographics survey**, our second survey was a **group matching survey**, our third survey was an **initial evaluation survey** and our fourth survey was a **final evaluation survey.** I include more specific information about the surveys and their questions in Section A.2 in the Appendix.

Understanding preferences and group formation

Our first two surveys were meant to collect information that we used for the group formation and understanding preferences. Below are the surveys

Demographics Survey

Through this survey, we were able to collect demographic information and highlight the importance of diversity to enable students to understand that we hoped to have an inclusive experience in the class by using the information collected. The questions asked in the survey are included in section A.2.

Group Matching Survey

Our second survey was a group matching survey in which we asked students questions about the classes they were taking, their prior experience with programming, how much time they wanted to spend working on the class, and their scheduling and study preferences. In the group matching survey, we aimed to collect student preferences so that we could use this information to match the students into their study groups. We got information in order to form the groups based on whether the students already knew their teams or if they wanted to form new groups in the class. The grouping matching form referenced in A.2.

Reassignment Survey

We gave students a chance to request for reassignment after two weeks of trying out a study group for any reason whatsoever. The reason behind allowing reassignment was because sometimes, groups do not work out for unforeseen reasons; we wanted to make sure that students get a chance to find and work with a study group regardless of failure to have a functional study group initially. Some students had trouble connecting with other students because of scheduling issues or simply did not get along with the study group members. Our reassignment gave them a chance to try out a new study group. We asked the same questions as the group matching survey to get answers and match the students to their new groups.

Feedback

We constructed two feedback surveys; the initial evaluation survey and the final evaluation survey. We designed the questions in the feedback surveys using the Likert scale [35]. We chose to use the Likert scale [35] in our survey design but we eliminated the midpoint. Removing the midpoint eliminates the possibility that respondents might misuse the point

[36]. Furthermore, some respondents might choose to select a midpoint rather than selecting socially undesirable options [37]. Studies have been done to show that the presence of a midpoint can promote satisfying behaviour and social desirability bias [38]. In order to get results that reflected how the students actually felt, we decided to eliminate this neutral point and have a scale of 1-4.

Initial Evaluation Survey

The first study group evaluation form was meant to check in and see if students were able to connect with their groups and how they felt about their groups. We had four sections in this form where each section queried the students for different information. We checked whether or not the students were able to connect with all or some of the study group members. We also queried the students in order to understand the group dynamics of the study groups. We wanted to know whether the students felt comfortable asking questions and sharing ideas in their study groups. We also gave the students a chance to ask for reassignment in this survey if they did not feel comfortable with their current group. The initial evaluation survey is referenced in A.2

Final Evaluation Survey

The goal of this survey referenced in A.2 was to get an overall idea of how this experiment worked out. We wanted to know whether the students felt comfortable asking questions and sharing ideas in their study groups. We also hoped to get feedback meant to improve the study group experience for future semesters. We used this survey to get consent on whether we could use individual student data.

2.4 Study guidelines

We provided overall guidelines that detailed the conduct and responsibilities of the students in the study group. The guidelines were meant to show students how to run the first and subsequent meetings. The first meeting interaction was focused on encouraging the team members to get to know each other while subsequent meetings involved completing the homework together.

Our guidelines emphasized the importance of study groups and urged the students to respect each other and create a welcoming space for everyone to ask questions. Also, the study guidelines were a chance for the students to understand what collaborative platforms they could use to work together on the homework. More importantly, the guidelines highlighted that the team should be made up of different roles to enable everyone to participate in the study group. We chose roles similar to [39] . The following roles and descriptions were given to the students as part of the guidelines to facilitate the workflow: Facilitator, Librarian, Scribe, Timekeeper described in detail in A.1.

Because the study groups were primarily meant to enable the students to work together on the class assignments and study for exams together, the first meeting guidelines encouraged the students to go over some ice breakers, choose a meeting time and then try to attend discussion and homework party together. The second and subsequent meeting guidelines

were based on working on the assignments together and making sure everyone's questions were answered.

2.5 Our design

Our design avoided having singletons from a demographic category in each group. Although this was a major factor considered in forming the groups, the other survey questions referenced in A.2 were also important in compatible and effective collaboration indicators such as time zone, classes taken and year in school. Using a software generated by the EECS16A Teaching Assistants (TAs), the groups were formed in a way that they first matched the students who explicitly requested teammates, before matching based on preferences. As an example, a student in a time zone such as California's Pacific Standard Time (PST) would not be paired with a student in a European Coordinated Universal Time (UTC) zone; to ensure that the students are able to meet, considering time zones is a priority. However, other factors like class level and classes taken were also considered if the matches could be found since these can lead to member similarities and longer collaborations beyond the EECS16A course. After the software matched the students, they were informed that the groups had been formed, they were able to see the group matches on Gradescope [40] if they participated in the group matching.

Chapter 3

Results

This section entails the results from analyzing the student feedback that was submitted in the final evaluation survey referenced in A.2. 503 students participated in the study groups. However, 472 students consented to us using their data from which the results below are derived. To analyze the results, research questions were answered using data analysis of the student survey responses.

The research questions were grouped into six categories in order to capture the overall experience of the students. The categories were: 1) **grouping composition preferences**, 2) **new students experiences**, 3) **inclusive structure of the study groups**, 4) **reassignment of the students**, 5)**interaction frequency,** and 6) **future plans of students in the study groups**.

The research questions investigated the overall experience of the students from the different demographic categories in the study groups. Out of the 472 students who consented to us using their data, 318 were Freshmen, 72 were Sophomores, 63 were Junior Transfers, 15 were Juniors, 3 were Senior Transfers and 1 was a Senior. Students who wanted to self-match were allowed to do so and students who wanted us to match them using the information entered in the forms were allowed to do that as well.

Our main results are based on student responses to our feedback survey. We primarily analyze the answers to the following four questions, which students answered on a scale of 1-4, with 1 being mostly uncomfortable and 4 being mostly comfortable.

1. **Question 1 : Do you think most people in your group are comfortable sharing ideas with the group?**
2. **Question 2 : Are you comfortable sharing ideas with the group?**
3. **Question 3 : Do you think most people in your group are comfortable asking questions in the group?**
4. **Question 4 : Are you comfortable asking questions in the group?**

We considered the responses to these questions in the grouping composition preferences, new student experiences, inclusive structure of the study groups, participation, interaction frequency, and reassignment of the students contexts. In the subsequent sections, we use the questions to understand the experience of the students in their study groups.

Furthermore, we asked a question to find out how interested students were in having the same people in their groups for the future semesters as a way of understanding the experience of the student outside of how comfortable they felt within the group specifically referenced in 3.7.

3.1 Grouping composition preferences

Some students chose to self-match into groups. On the other hand, students who did not have people to be matched with were matched by the software. Students who did not want to participate in the study groups also had the choice not to do so. We wanted to give the students the agency to make the choices about the study groups. Our reasoning behind giving the students agency to choose between self-matching and being matched by the software was to avoid forcing students into groups when they already had preferred students to work with; forcing students into unwanted groups could have negative consequences.

The grouping composition preferences research question is:

1. **How did the experience of students who self-matched compare to the experience of the students who were matched into the study groups?**

   140 students self-matched into study groups with people that they already knew. Figure 3.1 and table 3.1 show the experiences of the students who self-matched into the study groups.

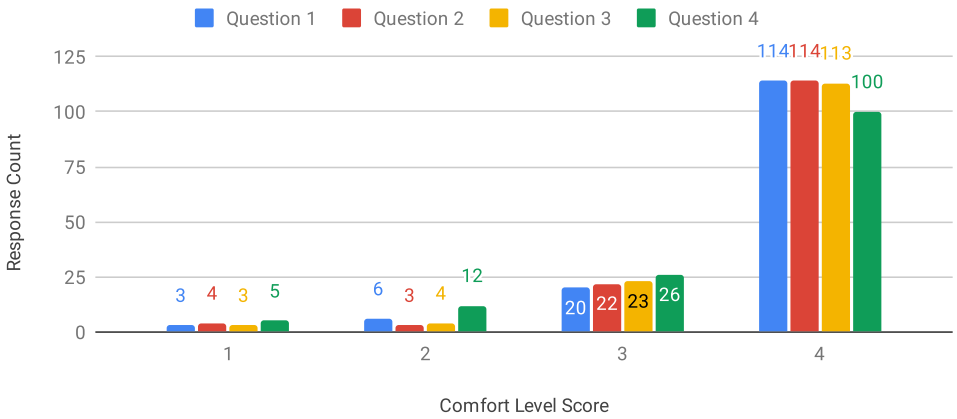

Figure 3.1: Response count to questions one through four of students who self-matched into the study groups.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.1: This table shows the median value for responses of the students who self-matched into groups.

332 students were matched by the software. Figure 3.2 and table 3.2 show the experiences of the students who were matched by the software.

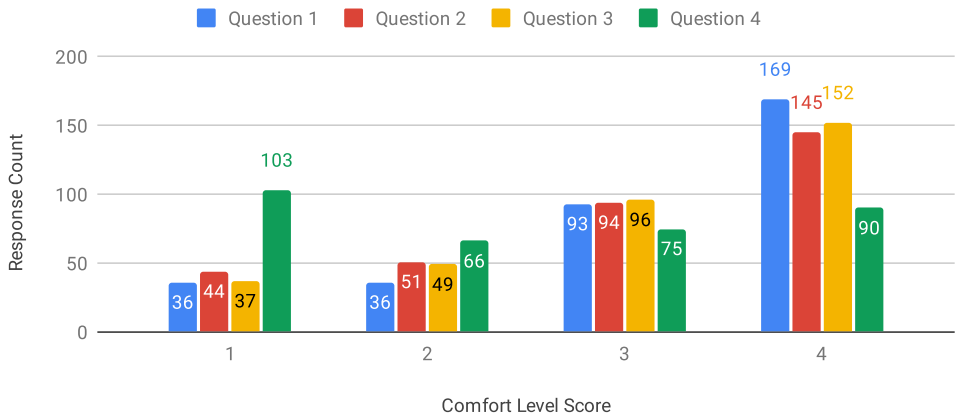

Figure 3.2: Response count to questions one through four of students who were matched into groups by the software.

	Question 1	Question 2	Question 3	Question 4
Median	4	3	3	2

Table 3.2: This table shows the median value for responses of the students who were matched into groups by the software.

A key observation is that students who self-matched were more comfortable asking questions and sharing ideas in the study groups than students who did not self-match into the study groups. We speculate that the students who self-matched had already established a bond allowing them to easily figure out when to meet, plan their schedules, and talk more comfortably amongst each other. On the other hand, students who were meeting for the first time had to first get to know each other in a remote setting and plan to work with each other remotely. One of the challenges of remote learning is coordinating schedules, arranging meetings, meeting, corresponding, make decisions collectively, integrating the contributions of group members, etc [41]. Students who already know each other have developed relationships and therefore are able to jump right into coordination which gives them more time to work together since they have one homogeneous factor of friendship. This could have played a role in making the experiences of the students who self-matched better.

3.2 New students' experiences

The new students in a typical semester are usually freshmen and junior-transfers. In the study groups formed using the software, we wanted to match students in the same year with

each other so that they could take some more classes together or work on their other classes together outside class.

The new student experience research question is:

1. **How did the study group experience of new students (freshmen students and junior-transfers) compare to students who had been in the school longer?**

   We had 318 freshmen students. Figure 3.3 and table 3.3 show the experiences of the freshmen students in the study groups.

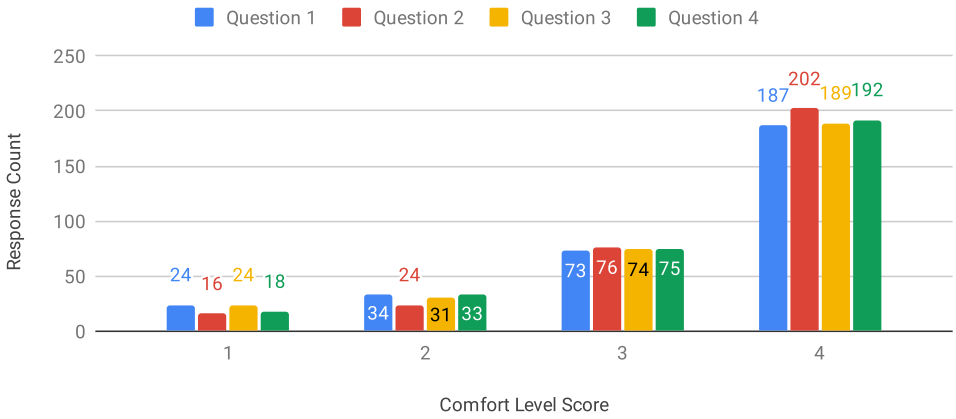

Figure 3.3: Freshman response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.3: This table shows median value of the responses of freshmen students.

We had 72 sophomore students. Figure 3.4 and table 3.4 show the experiences of the sophomore students in the study groups.

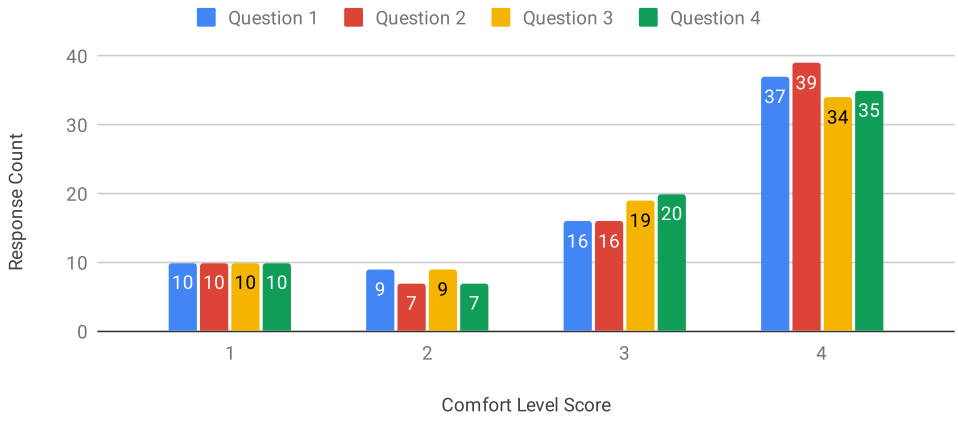

Figure 3.4: Sophomore response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	3	3

Table 3.4: This table shows the median value of the responses of sophomore students.

We had 15 junior students. Figure 3.5 and table 3.5 show the experiences of the junior students in the study groups.

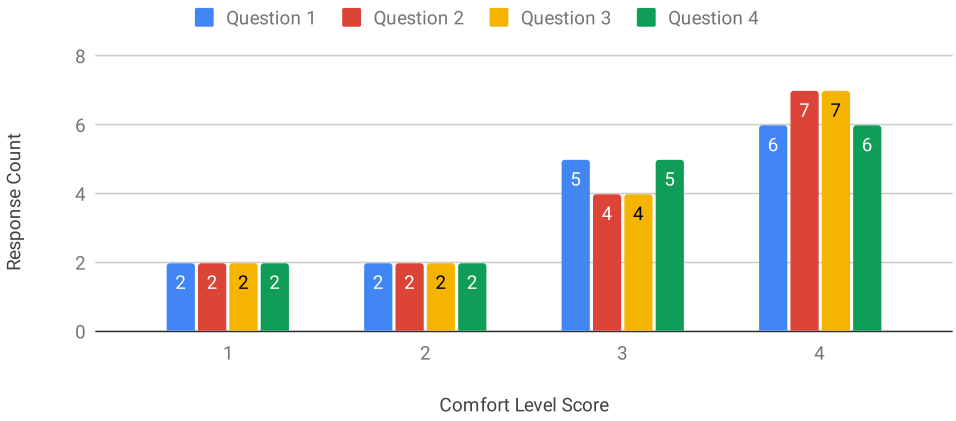

Figure 3.5: Junior response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.5: This table shows the median value of the responses of junior students.

We had 63 junior-transfer students. Figure 3.6 and table 3.6 show the experiences of the junior-transfer students in the study groups.

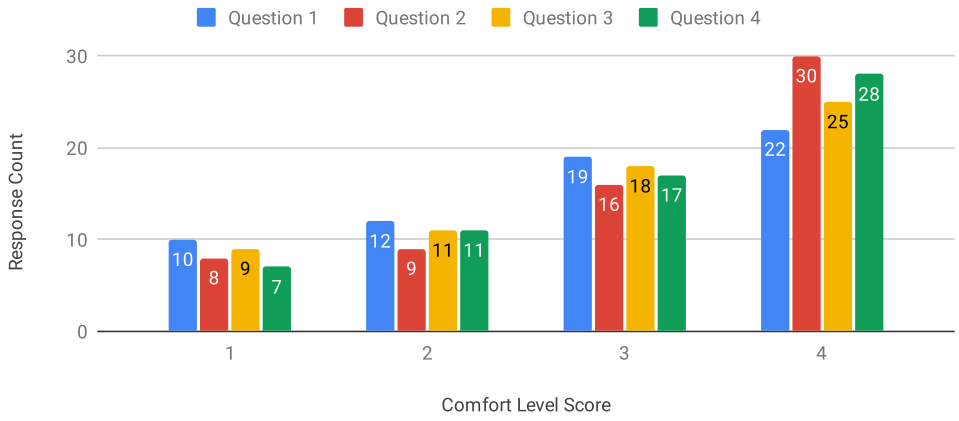

Figure 3.6: Junior-transfer response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.6: This table shows the median value of the responses of junior-transfer students.

Based on this data, it is evident that freshmen and sophomores were more comfortable sharing ideas and asking questions in the study groups compared to all the other year groups. This class has more freshmen students than other students since it is an introductory level class. Study groups facilitate learning, social function, and organization. A study among new students stated that a positive correlation would exist between the quality of new friendships developed at university and university adjustment [42], which could explain why freshmen students had a better experience than sophomore students and junior students.

3.3 Inclusive structure of study groups

The study groups were made such that there was no single student from one single demographic category in one group as referenced in 2.2. In the analysis, we investigate the experience of students who are identified as underrepresented in STEM, students from different ethnic groups, women, men and gender non-conforming students. We contrast and compare the experiences of the students in the different demographic categories.

The research questions for inclusive structure of the study groups are:

1. **How did the study group experience of students who identified as historically underrepresented in STEM compare to the students who said that they did not identify as historically underrepresented in STEM?**

We had 94 students who identified as historically underrepresented in STEM. Figure 3.7 and table 3.7 show the experiences of the students who identify as historically underrepresented in STEM in the study groups.

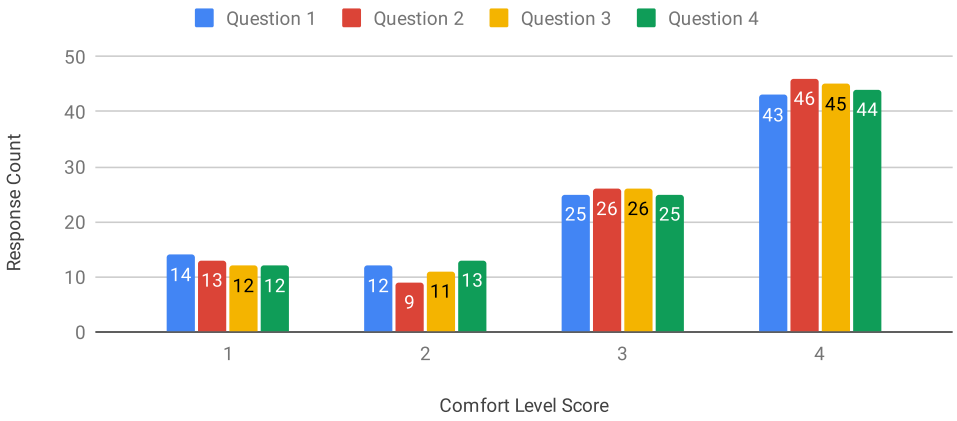

Figure 3.7: Students who identified as historically underrepresented in STEM response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.7: This table shows the median value of the responses of students who identify as historically underrepresented in STEM.

We had 73 students who identified as maybe historically underrepresented in STEM. Figure 3.8 and table 3.8 show the experiences of the students who maybe identify as historically underrepresented in STEM in the study groups.

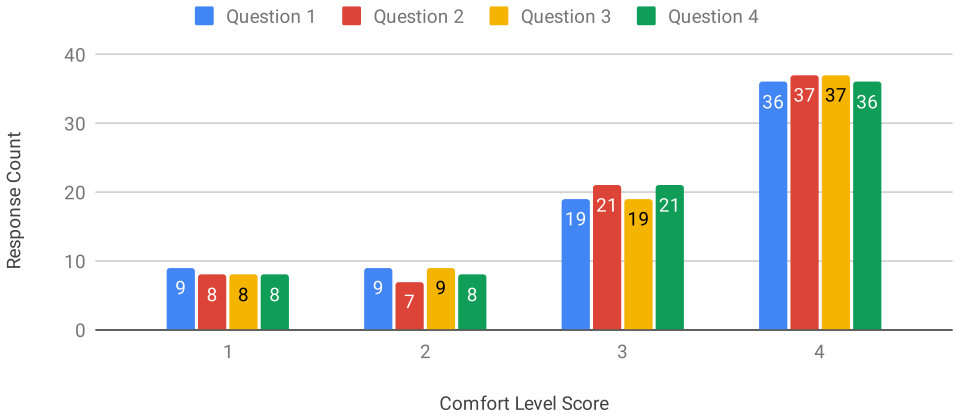

Figure 3.8: Students who identified as maybe historically underrepresented in STEM response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	4	4	3

Table 3.8: This table shows the median value of the responses of students who identify as maybe historically underrepresented in STEM.

We had 290 students who identified as not historically underrepresented in STEM. Figure 3.9 and table 3.9 show the experiences of the students who do not identify as historically underrepresented in STEM in the study groups.

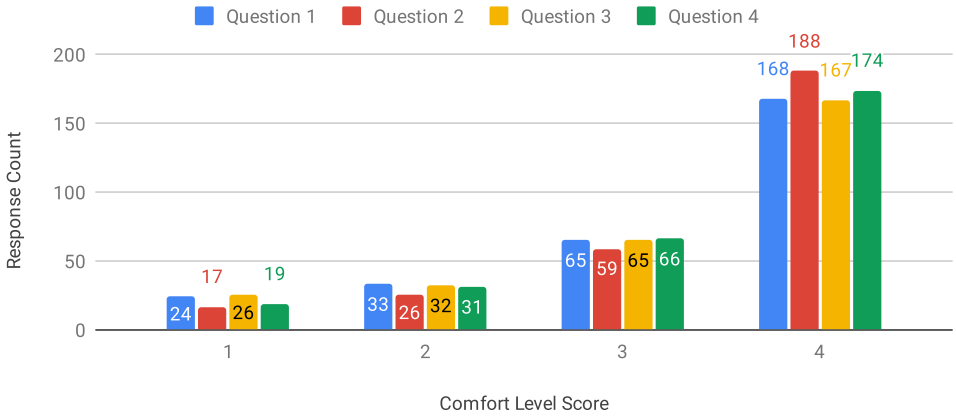

Figure 3.9: Students who identified as not historically underrepresented in STEM response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.9: This table shows the median value of the responses of students who do not identify as historically underrepresented in STEM.

We see that the median response for all questions for people who identified as historically underrepresented in STEM is 3, whereas the median for people who did not identify as historically underrepresented in STEM is 4 for all the questions. Based on this data, it seems that students who did not identify as historically underrepresented had a slightly better experience than students who identified as historically underrepresented in STEM.

2. **How did the study group experience of female-identifying students and gender non-comforming students compare to male-identifying students?**

We had 139 female-identifying students. Figure 3.10 and table 3.10 show the experiences of the female-identifying students in the study groups.

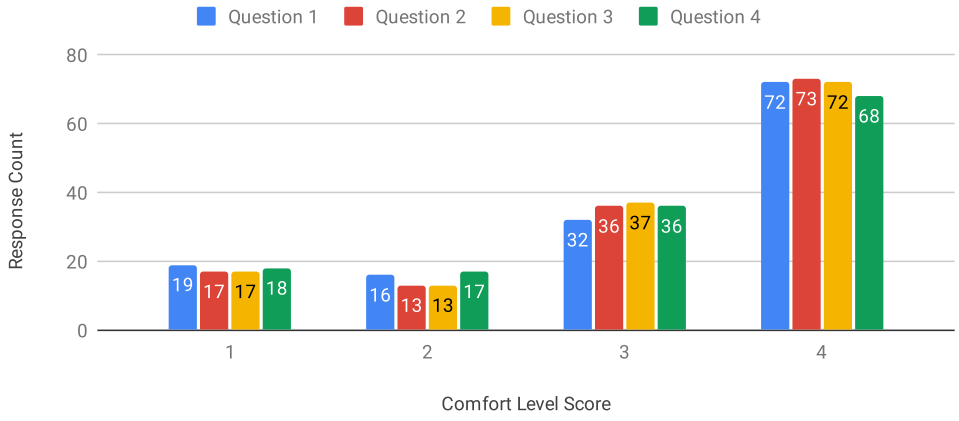

Figure 3.10: Female-identifying students response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	3

Table 3.10: This table shows the median value of the responses of female-identifying students in the study groups.

We only had two students who said that they identify as gender non-conforming so this is a small number and therefore the results reflect a very small sample space. Figure 3.11 and table 3.11 show the experiences of the gender non-comforming students in the study groups.

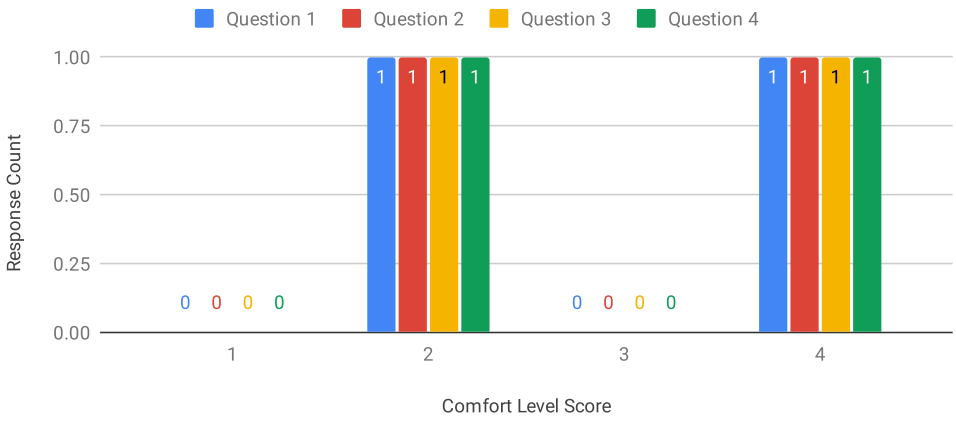

Figure 3.11: Gender non-comforming students response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.11: This table shows the median value of the responses of the students who identify as gender non-conforming students in the study groups.

We had 321 male-identifying students. Figure 3.12 and table 3.12 show the experiences of the male students in the study groups.

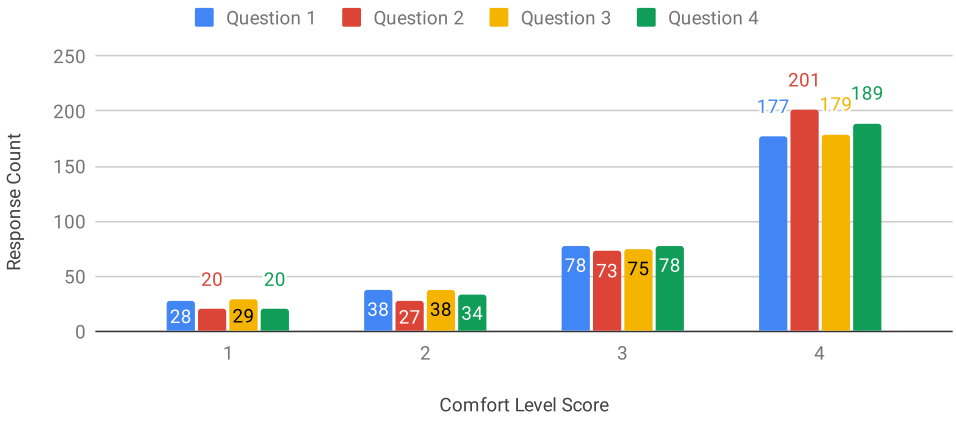

Figure 3.12: Male-identifying students response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.12: This table shows the median value of the responses of male-identifying students in the study groups.

Male students more often said that they were comfortable asking questions compared to female students and gender non-conforming students. The experience of male-identifying students and female-identifying students is pretty similar. We had 321 male students out of the 472 students that consented to us using their data. Although our groups were designed to ensure that there was not one person from a specific demographic category alone in the study groups, there were very few instances where time zone/location caused a few women to be placed in groups where there was not more than one other female-identifying student. This was meant to enable group practicality in an online semester. So much research has been done to explain why it is important to have more than one woman in the study group, which is explained in Section 2.2. Given the fact that there are fewer women than men in the class, achieving this in the groups can be difficult if the time zones do not align.

3. **How did the study group experience compare across different racial/ethnic groups?**

We had three black students. Figure 3.13 and table 3.13 show the experiences of the Black students in the study groups.

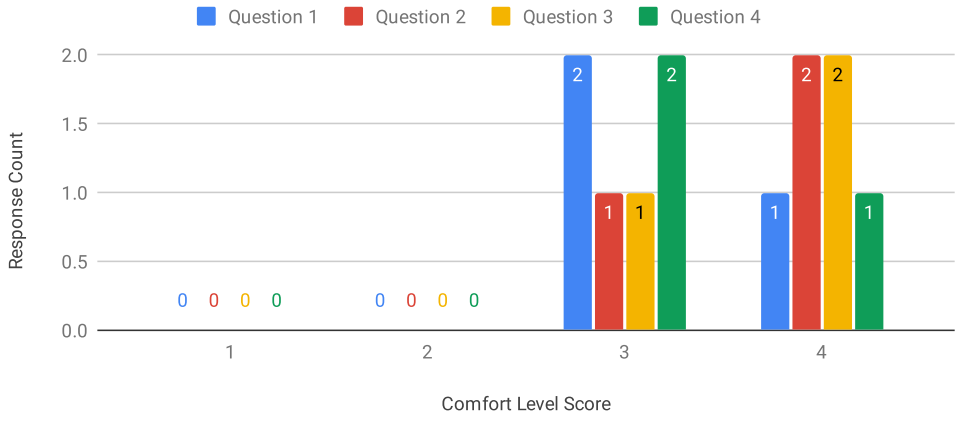

Figure 3.13: Black students' response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	4	4	3

Table 3.13: This table shows the median value of the responses of Black students in the study groups.

We had 24 Hispanic students. Figure 3.14 and table 3.14 show the experiences of the Hispanic students in the study groups.

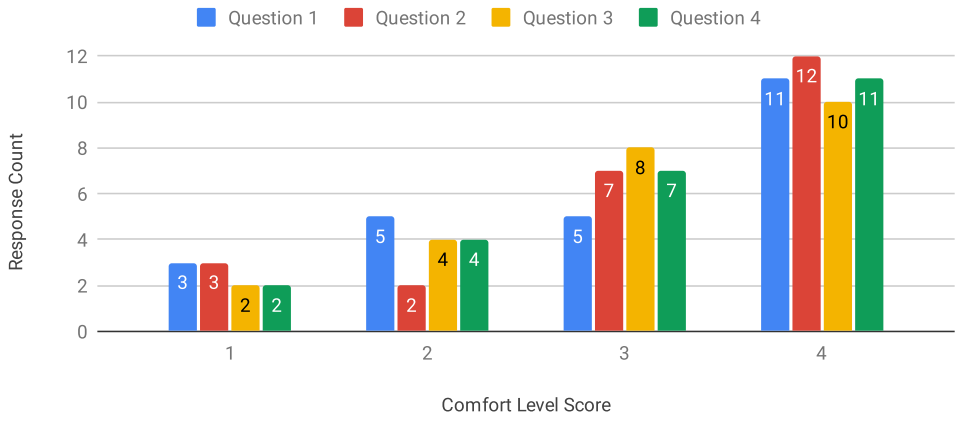

Figure 3.14: Hispanic students' response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	3.5	3	3

Table 3.14: This table shows the median value of the responses of Hispanic students in the study groups.

We had 321 Asian students. Figure 3.15 and table 3.15 show the experiences of the Asian students in the study groups.

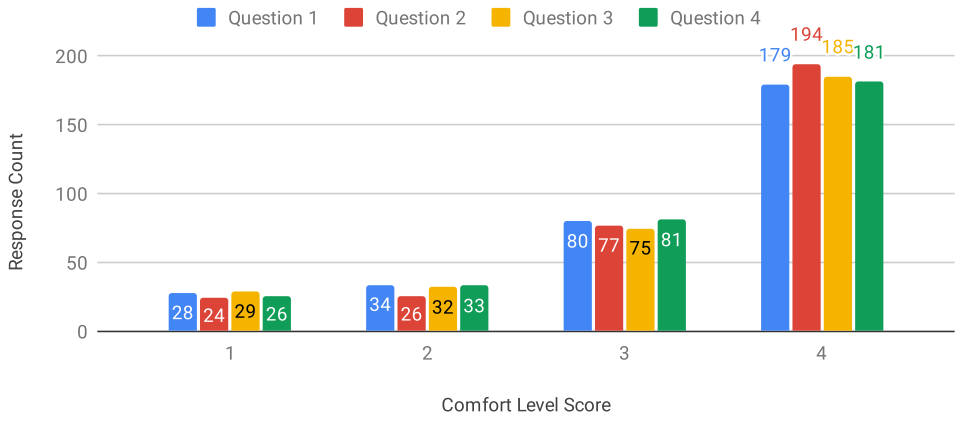

Figure 3.15: Asian students' response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.15: This table shows the median value of the responses of Asian students in the study groups.

We had 57 White students. Figure 3.16 and table 3.16 show the experiences of the White students in the study groups.

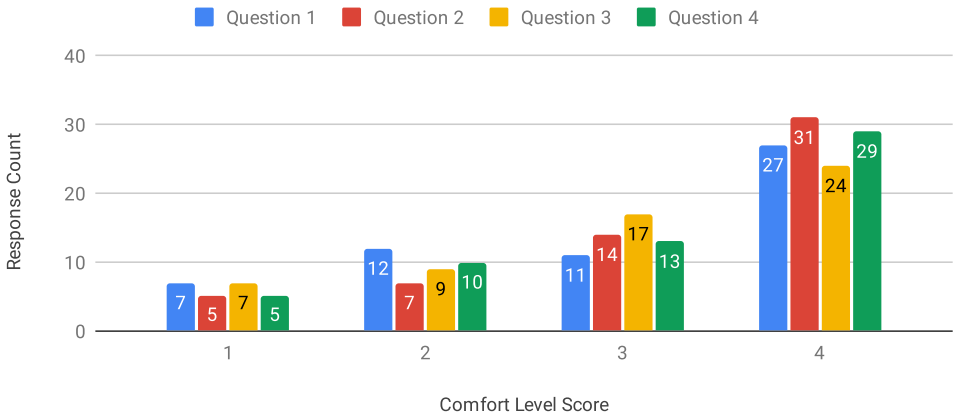

Figure 3.16: White students' response count to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	4	3	4

Table 3.16: This table shows the median value of the responses of White students in the study groups.

The experience of the students from the different races/ethnic groups is not that different. We took demographics into consideration in the design of the study group to ensure that all students felt comfortable as referenced in 2.2.

3.4 Reassignment

Although we formed the groups at the start of the semester, we gave students a chance to request for reassignment after two weeks of trying out a group and not feeling comfortable being in the group or being unable to schedule meetings or for any other reason. We anticipated that a group could fail to work out for any reason ranging from scheduling to personal compatibility of the team members. By analyzing how comfortable students who did not do reassignment felt compared to those who did, we get to understand how reassignment could have affected the students' experiences. Out of 472 students, 358 students did not do any reassignment. This is about 75 percent of the students who consented to us using their data for this research. The students who did not do any reassignments were more comfortable asking questions and sharing ideas in their study groups than students who were later reassigned to other study groups as shown by the figures and tables below.

The reassignment research question is:

1. **How did the study group experience of students who did not get reassigned to any other study groups compare to those who got reassigned to other study groups?**

   We had 358 students who did not do any reassignment. Figure 3.17 and table 3.17 show the experiences of students who never requested for a reassignment in the study groups.

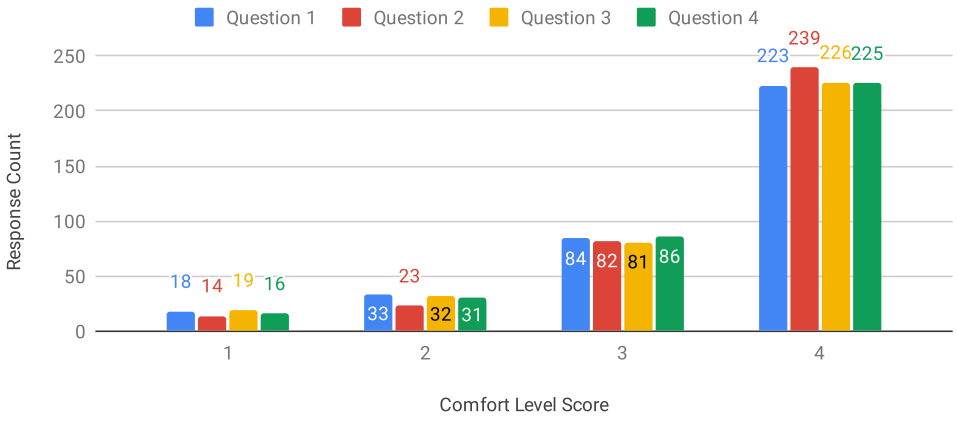

Figure 3.17: Response count to questions one through four of students who never got reassigned to other study groups.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.17: This table shows the median value of the responses of students who did not get reassigned to other study groups.

We had 102 students who did one reassignment. Figure 3.18 and table 3.18 show the experiences of students who requested for one reassignment in the study groups.

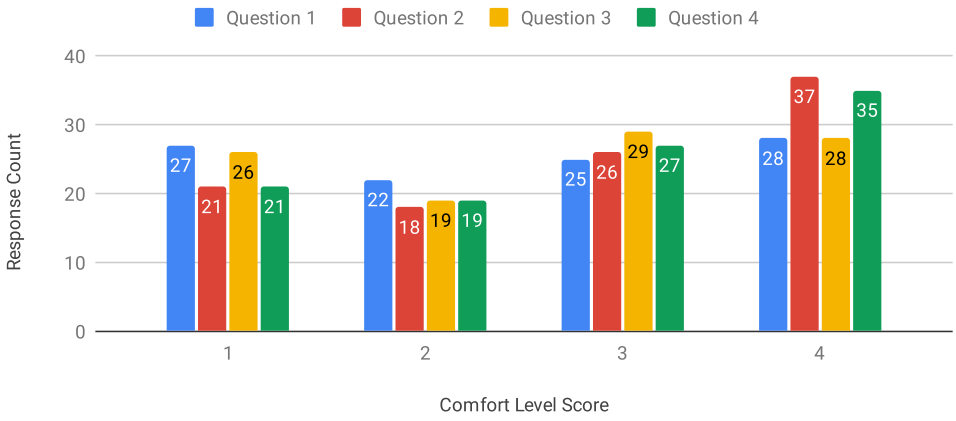

Figure 3.18: Response count to questions one through four of students who got reassigned once to another study group.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.18: This table shows the median value of students who did one reassignment to another study group.

We had 11 students who did two reassignments. Figure 3.19 and table 3.19 show the experiences of students who requested for two reassignments in the study groups

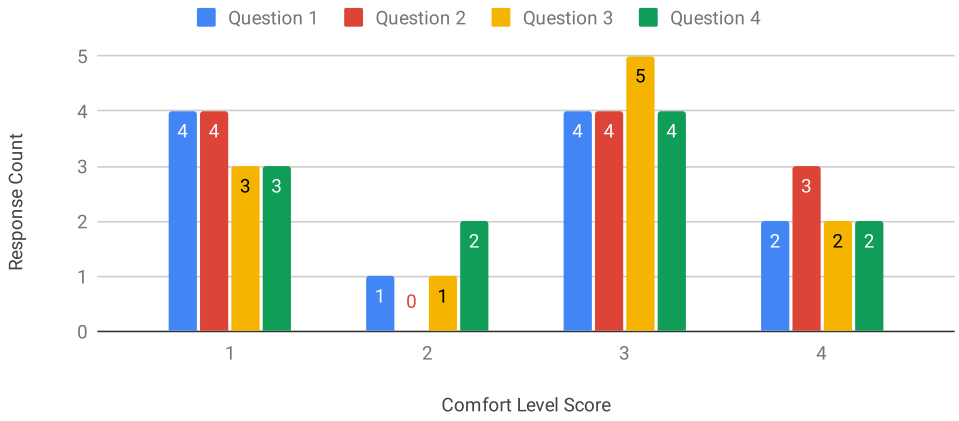

Figure 3.19: Response count to questions one through four of students who got reassigned twice to other study groups.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.19: This table shows the median value of the responses of students who were reassigned to two other study groups.

Based on the data, the students who did not do any reassignment were more comfortable asking questions and sharing ideas in their groups than students who did one or two reassignments.

3.5 Interaction frequency

We asked the students how often their groups interacted (met/texted/chatted) with each other to understand how the interaction frequency affected their experience in the study groups. We surveyed how this interaction frequency affected how comfortable the students felt in the study groups and below are the results from that analysis. We further broke it down in terms of the demographic category to fully understand the experience of students from the different demographic groups based on interaction frequency.

How did the students who interacted more than twice a week feel about the study groups in comparison to students who interacted twice a week or less?

63 students interacted more than twice a week. Figure 3.20 and table 3.20 show the experiences of students who interacted more than twice each week.

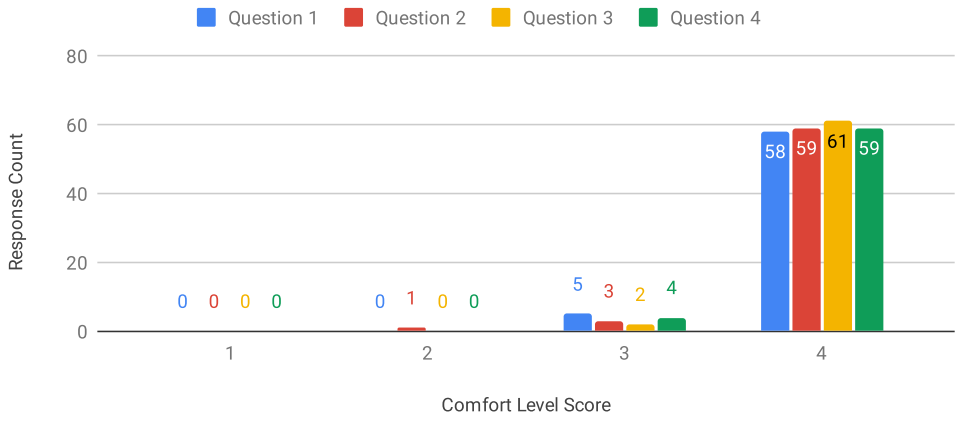

Figure 3.20: Response count of students who interacted more than twice a week to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.20: This table shows the median value of the responses of students who interacted more than twice a week.

45 students interacted twice a week. Figure 3.21 and table 3.21 show the experiences of students who interacted twice each week.

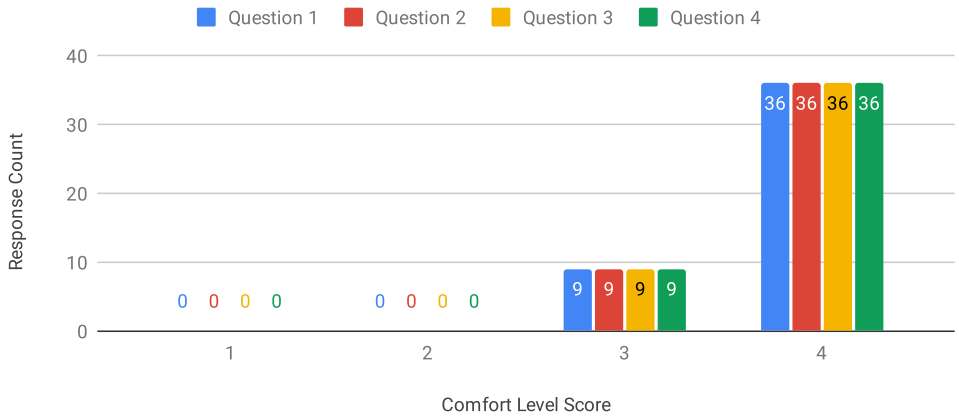

Figure 3.21: Response count of students who interacted twice a week to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.21: This table shows the median value of the responses of students who interacted twice a week.

213 students interacted once a week. Figure 3.22 and table 3.22 show the experiences of students who interacted once each week.

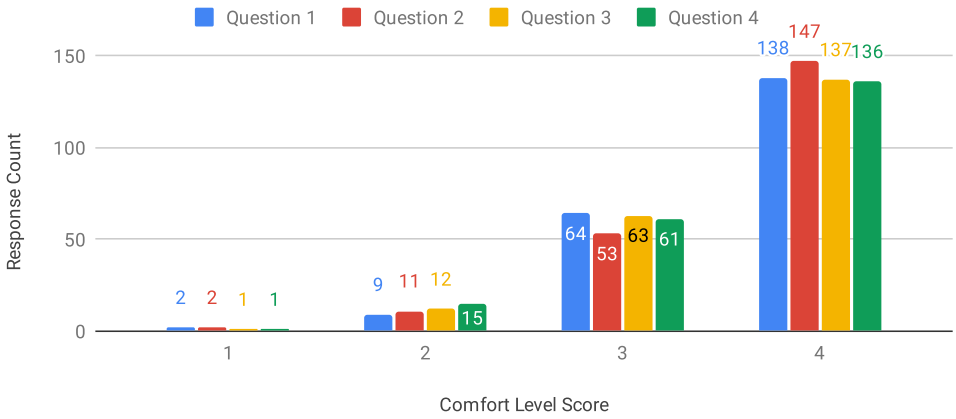

Figure 3.22: Response count of students who interacted once a week to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.22: This table shows the median value of the responses of students who interacted once a week.

151 students never interacted with each other. Figure 3.23 and table 3.23 show the experiences of students who never interacted each week.

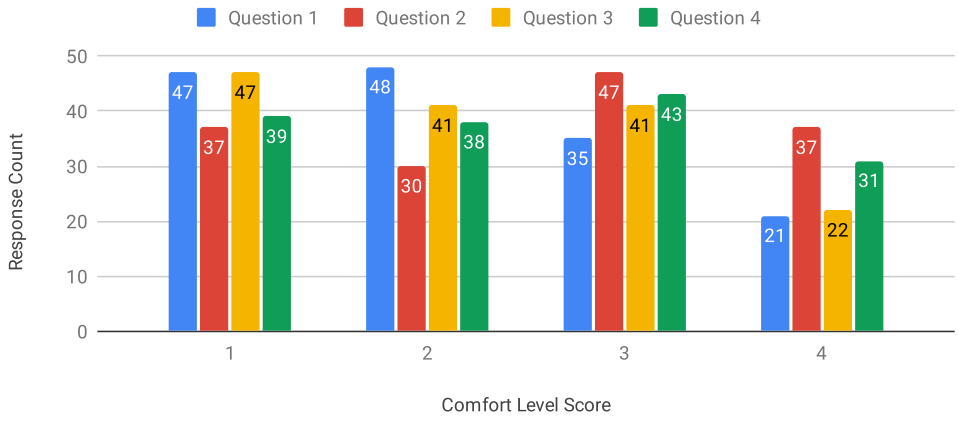

Figure 3.23: Response count of students who never interacted to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	2	3	2	2

Table 3.23: This table shows the median value of the responses of students who never interacted.

Students who interacted more than twice a week were more comfortable asking questions and sharing ideas than students who interacted twice a week or less.

Study group experience of students who interacted more than twice a week	
Count (n)	Demographic category
48	Freshmen
5	Sophomores
2	Juniors
8	Junior Transfers
45	Male students
15	Female students
1	Gender non-conforming
1	Black students
4	Hispanic students
43	Asian students
6	White students

Table 3.24: This table shows the count of students from different demographic categories in groups where students interacted more than twice a week.

Study group experience of students who interacted twice a week	
Count (n)	Demographic category
37	Freshmen
4	Sophomores
1	Juniors
3	Junior Transfers
29	Male students
16	Female students
0	Gender non-conforming
0	Black students
3	Hispanic students
35	Asian students
2	White students

Table 3.25: This table shows the count of students from different demographic categories in groups where students interacted twice a week.

Study group experience of students who interacted once a week	
Count (n)	Demographic category
150	Freshmen
33	Sophomores
7	Juniors
22	Junior Transfers
150	Male students
61	Female students
0	Gender non-conforming
2	Black students
9	Hispanic students
150	Asian students
27	White students

Table 3.26: This table shows the count of students from different demographic categories in groups where students interacted once a week.

Study group experience of students who never interacted	
Count (n)	Demographic category
83	Freshmen
30	Sophomores
5	Juniors
30	Junior Transfers
97	Male students
47	Female students
1	Gender non-conforming
0	Black students
8	Hispanic students
93	Asian students
22	White students

Table 3.27: This table shows the count of students from different demographic categories in groups where students never interacted.

The graphs that show the different experiences of students based on student interaction frequency are shown in A.3.

It is evident that students who interacted more than twice a week from the different demographic categories were the most comfortable asking questions and sharing ideas in their groups regardless of the demographic categories that they were from. Students who did not interact had the worst experience in the study groups across the different demographic categories.

In summary, we speculate that the students who put in the work to interact with their group members benefited the most from the study groups because they were more comfortable asking questions and sharing ideas. Although we formed the study groups for the students, it was up to them to find time to interact with each other.

3.6 Student participation in the groups

We asked the students how often everyone in the groups participates. We checked how the rate of participation of the students affected how comfortable the students felt in the study groups and below are the results from that analysis.

How comfortable were the students in the study groups where everyone regularly participated compared to the students in study groups where people participated less?

159 students said that everyone regularly participates. Figure 3.24 and table 3.28 show the experiences of the students in study groups where everyone participated.

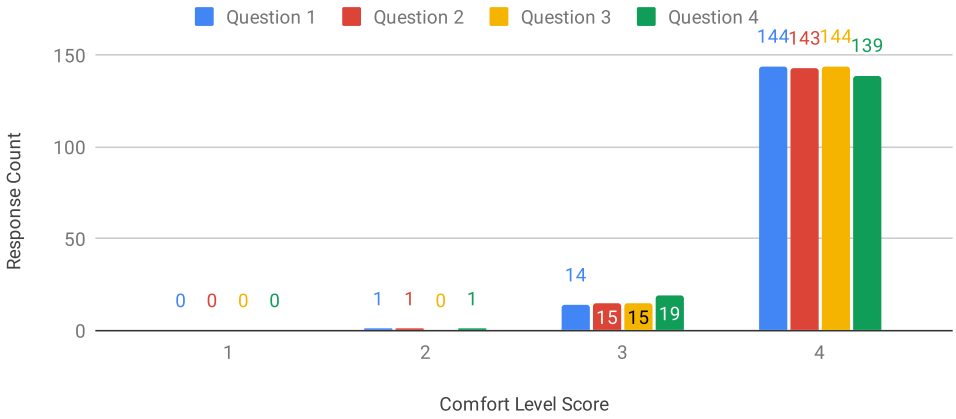

Figure 3.24: Response count of students who said that everyone regularly participates to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.28: This table shows the median value of the responses of students who said that everyone regularly participates.

93 students said that most people participate in the study groups. Figure 3.25 and table 3.29 show the experiences of the students in study groups where most students participated.

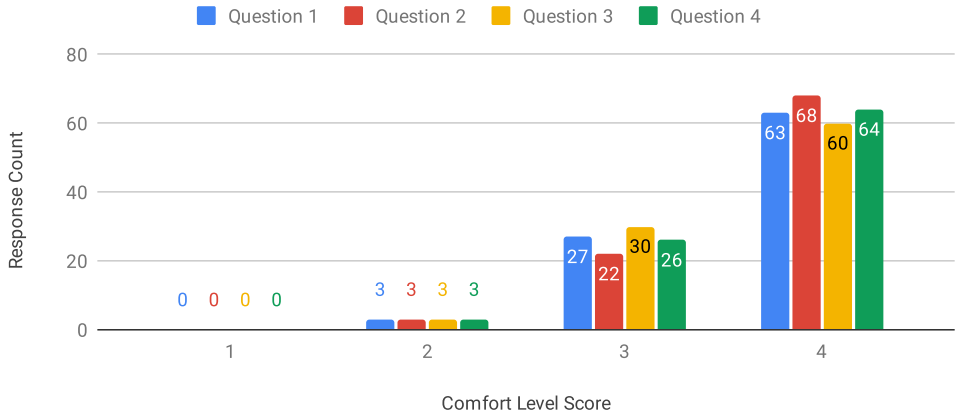

Figure 3.25: Response count of students who said that most people participate to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	4	4	4	4

Table 3.29: This table shows the median value of the responses of students who said that most people in the group regularly participate.

87 students said that some people participate in the study groups. Figure 3.26 and table 3.30 show the experiences of the students in study groups where most students participated.

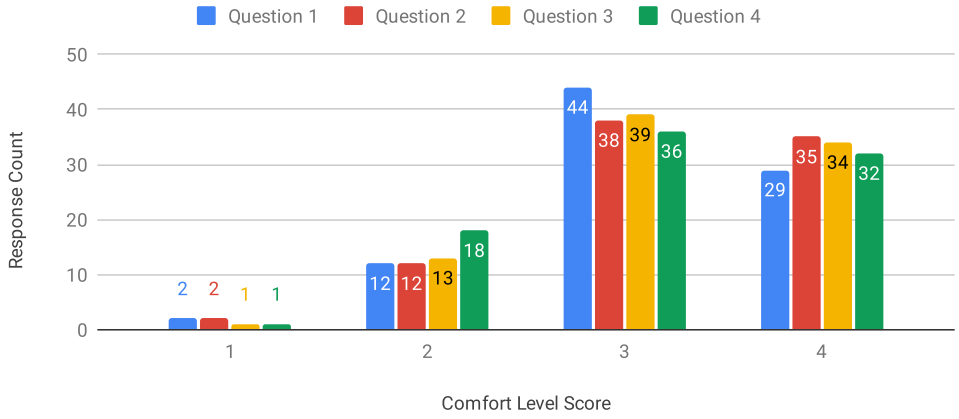

Figure 3.26: Response count of students who said that some people participate to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	3	3	3	3

Table 3.30: This table shows the median value of the responses of students who said that some people regularly participate.

133 students said that no one regularly participates in the study groups. Figure 3.27 and table 3.31 show the experiences of the students in study groups where most students participated.

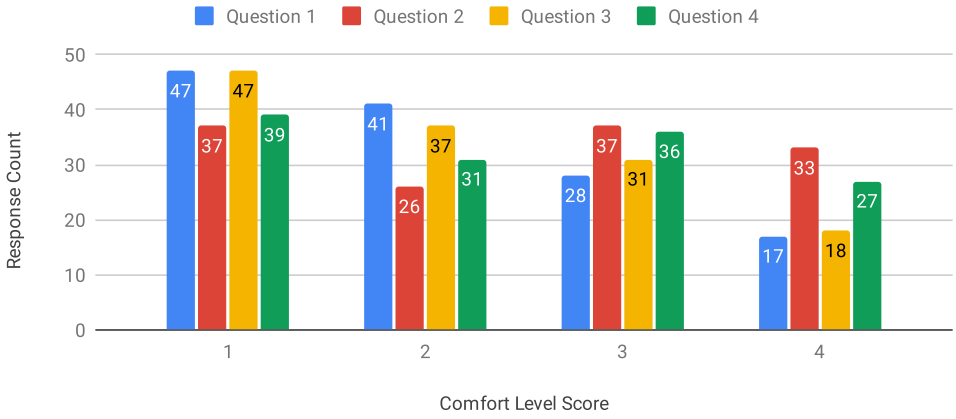

Figure 3.27: Response count of students who said that no one regularly participates to questions one through four.

	Question 1	Question 2	Question 3	Question 4
Median	2	3	2	2

Table 3.31: This table shows the median value of the responses of students who said that no one regularly participates.

Students in groups where everyone participated were more comfortable asking questions and sharing ideas in their groups. The difference in the experience between students who were in groups where everyone participated and students in groups where most people participated is slight. However, the students in groups where no one regularly participated seemed to have a worse experience than students in groups where everyone or most people participated.

Study group experience of students in groups where everyone participates	
Count (n)	Demographic category
121	Freshmen
19	Sophomores
5	Juniors
14	Junior Transfers
110	Male students
46	Female students
1	Gender non-conforming
1	Black students
5	Hispanic students
121	Asian students
13	White students

Table 3.32: This table shows the count of students from different demographic categories who were in groups where everyone participated.

Study group experience of students in groups where most students participate	
Count (n)	Demographic category
70	Freshmen
10	Sophomores
3	Juniors
10	Junior Transfers
69	Male students
23	Female students
0	Gender non-conforming
0	Black students
8	Hispanic students
62	Asian students
9	White students

Table 3.33: This table shows the count of students from different demographic categories who were in groups where most students participated.

Study group experience of students in groups where some students participated	
Count (n)	Demographic category
56	Freshmen
16	Sophomores
2	Juniors
12	Junior Transfers
55	Male students
30	Female students
0	Gender non-conforming
2	Black students
5	Hispanic students
57	Asian students
14	White students

Table 3.34: This table shows the count of students from different demographic categories who were in groups where some students participated.

Study group experience of students in groups where no students participated	
Count (n)	Demographic category
71	Freshmen
27	Sophomores
5	Juniors
27	Junior Transfers
87	Male students
40	Female students
1	Gender non-conforming
0	Black students
6	Hispanic students
81	Asian students
21	White students

Table 3.35: This table shows the count of students from different demographic categories who were in groups where no students participated.

The graphs that show the experiences of students from different demographic categories based on participation are shown in A.4. In groups where everyone participated, students felt very comfortable sharing ideas and asking questions compared to students in groups where fewer people participated regardless of demographic category. This data shows that participation of the students in the study groups is a key factor in the comfort of the students in the study groups.

3.7 Future plans of students in the study groups

Out of the 472 students, 326 students would like to take classes with their study group members in the future. This is approximately 70 percent of the participants. We did not ask the students why they would or would not like to take classes with their study group members.

Below are the percentages of students from different demographic categories who would be interested in taking classes with their study group members in the future.

	Interested in continued groups (%)
Freshmen	73
Sophomores	44
Juniors	60
Junior Transfer	55
Female	65
Male	67
Gender non-conforming	50
Black	100
Hispanic	67
Asian	69
White	51

Table 3.36: The percentage of students interested in continued groups based on student responses.

Based on this data, all the demographic groups wanted to take future classes with their study group members. Black students, Hispanic students male students, female students, and freshmen students had over 65 percent of students interested in continued groups. We speculate that those students had a great experience in their study groups and therefore wanted to work together again.

Chapter 4

Conclusion and future work

4.1 Conclusion

This work aims to create inclusive study groups and improve student collaboration. Simultaneously, this work also studies how to continuously improve the software to optimize the team matching process that students can benefit from. We also provide a deeper educational analysis of student group experiences from various perspectives. The goal is to improve the surveys as well as the team matching process and eventually use machine learning in the future to form better teams for students.

The students in the different demographic categories had a similar comfort level in their study groups. Further, many students wanted to take future classes with their study group members across the demographic groups. Important to note, all the Black students that took part in our research wanted to take classes with their study group members in the future. Although male students had a better experience asking questions and sharing ideas in their study groups than female students and gender non-conforming students, the difference is not big. The students from the different racial groups also had a similar experience and their comfort levels in the study groups do not vary significantly. The results of this project align with the sentiments from the post-study group informational interviews in which some students from the different demographic groups highlighted their positive experience taking part in the study groups.

4.2 Reflections

While there was much progress and students from the different demographic categories had similar comfort levels in the study groups, this project can be improved in the following ways.

- **Improve survey questions.**
  In both evaluation surveys, we asked a question about the students' experience in the

group and we wanted to know whether or not the students' groups contributed to their positive experience in 16A. The question was phrased like this: *Does your study group contribute positively to your experience in 16A? 1 means it does not contribute at all, and 4 means it contributes significantly.* However, we did not phrase the question in a way that inquired what positive experiences entailed. Positive experiences could vary based on their priorities such as homework completion, studying for exams, making friends, and feeling comfortable in a group. The question about the positive experience in 16A could have asked for more details on each student's experience.

Another question we asked the students was *Did your study group complete most of the questions on the homework together?* Homework completion with the study group was not a measure of how good the groups were and how comfortable the students were in the group. We encouraged the students to work on their homework individually beforehand and then take part in the study group to get clarification and discuss confusing concepts so this question does not investigate the experience of the students in the study groups accurately. This question could have been phrased to capture how many questions on the homework were discussed by the group rather than focusing on completion.

- **Take into account grading information.**

  Future work on the project could investigate how the study groups affected the grades of the students over the course of the semester. The work should evaluate the grades of the students in the different exams and track the progress to determine how helpful the study groups could have been. It would be important to notice if there was an improvement in the grades of the students who participated actively in the study groups.

- **Use Machine Learning to improve the study groups.** Machine learning could be used to improve the formation and evaluation of the study groups. Student sentiment written in words could be taken into consideration to understand how comfortable the students were in general and whether or not they had a great experience in the study groups.

Overall, this research will continue to improve the experience of all students so continued improvement is encouraged to ensure that the study groups formed meet the needs of the students and enable them to have a successful career. This project has been deployed in different classrooms to enable instructors to help students to find study groups and investigating the experiences of students in various classrooms would enable continued improvement on the project.

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Appendix A

Appendix

A.1 Study Guidelines

EECS16A general guidelines for how to run a successful study group:

What makes for effective study groups? First and foremost it is open communication and dedication from the group members. Here are some further guidelines on how we think you can run your group successfully.

- Study groups are a great way to meet new people and make friends! Everyone comes to the class with different experiences and backgrounds and preparation. Keep an open mind and be inclusive. Make people comfortable in asking questions.
- Asking and answering questions is a great way to develop a better understanding of the material.
- Respect each other in your study group and try to create a safe space in your study group. As people how they would like to be referred to. Keep things said in the group within the group as much as possible.
- Make the best effort to have a positive outcome for the group you are in.
- It might be helpful to assign group roles for the discussion and problem work time. Rotate these roles each week so everyone has a chance to do different things (e.g. alphabetically).
  - Facilitator: This individual is responsible for the flow of the group discussion and for making sure everyone has an opportunity to contribute and that everyone's ideas are being heard respectfully. Make sure that everyone is included.
  - Timekeeper: This individual is responsible for keeping time to make sure the group has a chance to try all the problems. Pose these questions to the group at the end: What can we review/study later that we didn't finish? What is confusing? What did we learn?

  - Librarian: Keep lecture notes open. Refer everyone to related content if your group gets stuck. The librarian can also read out the problems for everyone aloud.
  - Scribe: This individual is documenting the group's discussion (such as Jamboard or Awwboard. Both of these are also available as tablet apps. Everyone should submit their handwritten solutions to the HW, but the scribe can help document shared ideas. Sometimes it might be valuable to have multiple scribes in a group. You may have two scribes or two facilitators in a group if you have more than four students. A quick way to think of a good team is FIRST: a Friendly, Inclusive, Respectful, Structured Team.

First Meeting - Week of Homework 2

- Introduce yourselves and get to know each other. Maybe you can discuss the answers to questions like: What is your favorite pass-time activity or hobby? Do you have a dish you enjoy cooking? Do you have a dream destination for a holiday? What are you looking forward to learning in 16A?
- Pick 2-3 times in the week where your group will meet to discuss the homework. Make sure you add these to your calendar. We suggest meeting in 2+ hour blocks of time.
- We suggest having one meeting on Sunday/Monday soon after the HW is released, and another one on Wednesday/Thursday since the homework is due on Friday.
- Try to attend HW Party and Office hours as a group.
- At the end of the meeting, have a conversation to see if you would like to attend discussion sections together — if so pick a discussion time that works for everyone.
- It might be helpful to create a group chat on Messenger, Slack, or other platforms.

Subsequent Meetings

- Identify the meeting roles — make sure you rotate roles each week.
- Every person should suggest a few parts/sub-parts of the homework they would like to focus on for the meeting. The facilitator for the week should write these down.
- Quickly decide an order to discuss these problems. (Typically start with earlier problems first.) But make sure you are able to get to all the sub-parts that were brought up — no question is too easy or too hard to discuss. The facilitator should make sure that you are not spending too much time on any one problem.
- As a group make sure everyone's questions are answered.

- If you have time left, check to see if anyone has conceptual points they would like to discuss.
- It is okay to have a group meeting where everyone is just quietly working together and if someone has a question/gets stuck they pose it to the group. You don't have to be talking and interacting the whole time during your meeting.

Working in groups can sometimes inadvertently lead to people not feeling included or welcome. Take a minute to look through some of the micro-aggressions that might make someone in your group feel uncomfortable and how to interrupt them. Micro-aggressions article 1 Micro-aggressions article 2

A.2 Surveys

Demographics Survey

"We'd like to get to know you and use this information to improve your experiences in the class as well as the experiences of future generations of students. We are committed to creating a learning environment welcoming of all students that supports a diversity of thoughts, perspectives, and experiences, and respects your identities and backgrounds(including race/ethnicity, nationality, gender identity, socioeconomic class, sexual orientation, language, religion, ability, etc.)

- Name?
- Email?
- What year are you?
- Tell us about yourself. Where are you from? What is one of your hobbies?
- What timezone are you located in?
- People come to Berkeley from many different types of institutions and levels of preparation. Check the boxes that apply to help us understand your background. Note we do not expect exposure to linear algebra or programming — taking 61A in parallel is enough to keep up with the programming component in 16A.
- How do you self-identify? (Check all that apply)
- Which of these options best describes your race? (Check all that apply)
- Do you self-identify as belonging to a historically underrepresented group in STEM?

- It is unfortunate we are not able to be together on campus to start this semester — it is an unprecedented time. Are there any external challenges you anticipate having during this semester that we should be aware of? In case of any issues please always reach out to us at eecs16a@berkeley.edu

Group Matching Survey

Our second survey was a group matching survey in which we asked students questions about the classes they were taking, their prior experience with programming, how much time they wanted to spend working on the class and the In the group matching survey, we aimed to collect student preferences so that we could use this information to match the students into their study groups.

In the group matching form. We had five sections. `The first section included the following prompts;`

- First name?
- Last name?
- SID?
- Would you like to be part of an EECS 16A study group? (Answer yes even if you have an existing study group – follow-up questions to come)

`The second section was meant for students who answered yes to the last question of section one and the following prompts were given to the students`

- Do you have an existing study group of size 2-4 in mind? If you have a group of 5 or more, we recommend you split into two groups of size 2 and 3 respectively.

`The third section was a follow-up from the second section to collect the email addresses of students in case a student answered yes to the previous section. This was the prompt:`

- Group Members (write their email addresses)

`The fourth section included the required matching questions which everyone who needed us to form for them a study group was expected to fill out. We asked them the following prompts.`

- What is the UTC timezone offset closest to you?
- What year are you?
- What courses have you completed (or passed out of) before this?
- What other classes are you currently taking?

- How much time are you hoping to put into 16A?

There was a fifth section on optional matching questions in which we considered more personal preferences. This section was meant for students who wanted to improve the quality of their group match using the following prompts;

- What times of the day do you prefer meeting for your study group?
- How important is it to you that you are assigned to a group with one or more people that self-identify in terms of gender the same way as you? We will do our best to match you according to these preferences but may not always be able to.
- How important is it to you that your team is diverse and brings a variety of backgrounds to the group? We will do our best to match you according to these preferences but may not always be able to.

Initial Evaluation Survey

The first study group evaluation form was meant to check in and see if students were able to connect with their groups and how they felt about their groups so far. We had four sections in this form and different sections queried the students for different information.

In the first section, we basically meant to check whether or not the students were able to connect with all or some of the study group members. We asked them this question and provided multiple choice answers for them to pick one option.

- Have you been able to connect (i.e. be in contact with them via email and then meet) with your team members?

In the second section, we queried the students in order to understand the group dynamics of the study groups. The questions in this included;

- How often does your study group meet?
- Do you feel everyone in your group attends and participates in the study group meetings?
- Do you think that most people in your group are comfortable sharing their ideas with the group? 1 means most people are uncomfortable, 4 means most people are comfortable.
- Do you think that most people in your group are comfortable asking questions in the group? 1 means most people are uncomfortable, 4 means most people are comfortable.
- Does your study group contribute positively to your experience in 16A? 1 means it does not contribute at all, and 4 means it contributes significantly.
- How helpful were the study-group guidelines in helping you successfully run your group?

- Did your study group complete most of the questions on the homework together?
- Is there anything else you would like to let us know about your study group?

`In the third section, we asked students who did not feel comfortable with their current groups or who were not able to connect with their group members if they needed to be reassigned to new groups. We asked the following questions;`

- Would you like to be assigned to a different group?(In case you were not able to connect to the members of the group you were assigned to, or you do not like how your current study group is functioning, please let us know by filling out the study group form again to be assigned to a new group. If you have found a group that you would like to be associated with you can also let us know here: ¡insert reassignment survey¿
- If you want to continue working with someone you know (either through study groups or otherwise) but be paired with another small group of 1-3 people, then enter the email of that one person here. Make sure you both fill this form out and put each other's Berkeley emails (and double-check them!).

`In the fourth section, we asked students why they weren't interested in a study group by presenting this question.`

- Why are you not interested in a study group?(Please let us know why you prefer to not have a study group. This will help us improve our matching for future semesters.)

Final Evaluation Survey

The goal of this survey was to get an overall idea of how this experiment worked out and also get feedback meant to improve the study group experience for future semesters. At the start of the survey, we stated that; "Please let us know how your study groups are going. This allows us to improve the matching process for future semesters."

`In section one of the survey, we asked this question.`

- Did you choose to participate in an EECS 16A study group?

`In section two, we asked the following questions to understand how the study groups are doing.`

- Did you request a group reassignment at any point because the initial group you were assigned to did not work out? Please answer the subsequent questions based on your most recent group.
- Were you able to regularly interact (either via zoom, chat, messenger, discord, email or any other forum) with your group members?
- How often does your study group meet/interact/text/chat?

- Do you feel everyone in your group participates in the study group? Participation can involve zoom meetings, exchanging chat/text/other messages, emails etc.
- Do you think that most people in your group are comfortable sharing their ideas with the group? 1 means most people are uncomfortable, 4 means most people are comfortable.
- Are you comfortable sharing your ideas with the group? 1 means you are uncomfortable, 4 means you are comfortable.
- Do you think that most people in your group are comfortable asking questions in the group? 1 means most people are uncomfortable, 4 means most people are comfortable.
- Are you comfortable asking questions in the group? 1 means you are uncomfortable, 4 means you are comfortable.
- Does your study group contribute positively to your experience in 16A? 1 means it does not contribute at all, and 4 means it contributes significantly.
- Did your study group complete most of the questions on the homework together?
- Are you planning on taking future classes with people you met in your study group?
- What were your main obstacles to having a successful study group?
- Was there anything you think you could have done differently this semester to have a better study group experience?
- Is there anything else you would like to let us know about your study group?

`In section three, we asked the students who did not request a study group if they felt content with their choice not to have one.`

- Were you happy with your choice to not have a study group, or would you prefer to work with a group in future semesters? (Please elaborate in the text boxes below)
- If you prefer to not have a study group, could you explain why?
- If you prefer to have a study group in the future, could you explain why?
- Is there anything else you would like us to know?

`In section four, we asked students to provide consent to use their responses in the study by providing this text.` *"We would like to use your feedback for improving future iterations of this class and we need your consent! Please check below if we may do this. Your participation will have no impact on your grade. The PI for the study is Prof. Ranade and the Protocol ID is 2020-08-13526."*

"I consent to have anonymized information, feedback responses and scores used for research purposes so that the instructors may improve the efficacy of study groups in the future. I understand that no personally identifying information will be used."

- We asked the following question. Anonymized feedback and class scores and information may be used to improve future study groups. We ask that you please consent so we can improve the experience for the next set of students!

Reassignment Survey

We gave students a chance to request for reassignment after two weeks of trying out a study group for any reason whatsoever. The reason behind allowing re-assignment was because sometimes, groups do not work out for whatever reason so we wanted to make sure that students get a chance to find and work with a study group regardless of failure to have a functional study group initially. Some students had trouble connecting with other students because of scheduling issues or simply did not get along with the study group members and our re-assignment gave them a chance to try out a new study group.

In section one of the re-assignment survey, we asked the following questions.

- Name?
- Email Address?
- SID?
- Informally (not used for matching in any way), please briefly describe the reason you are re-submitting this form. This is for our own understanding, so we can optimize our matching for future iterations of this process

Following this, we asked the same questions as the group matching survey to get answers and match the students in new groups

A.3 Experience of students in different demographic categories based on interaction frequency

A.4 Experience of students in different demographic categories based on participation

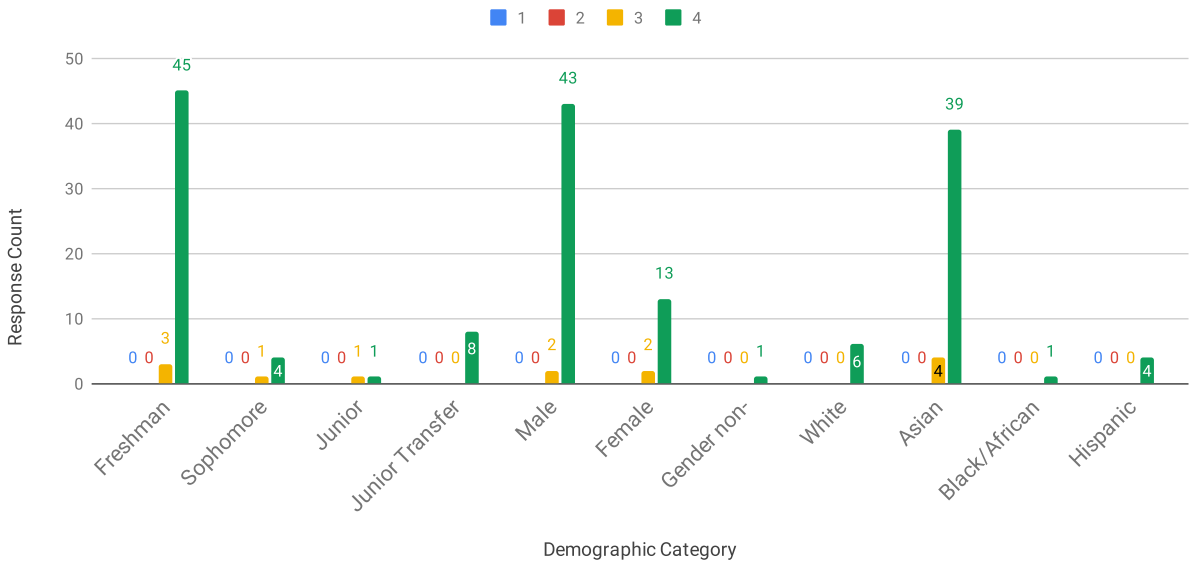

Figure A.1: Response count pf students who interacted more than twice a week to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

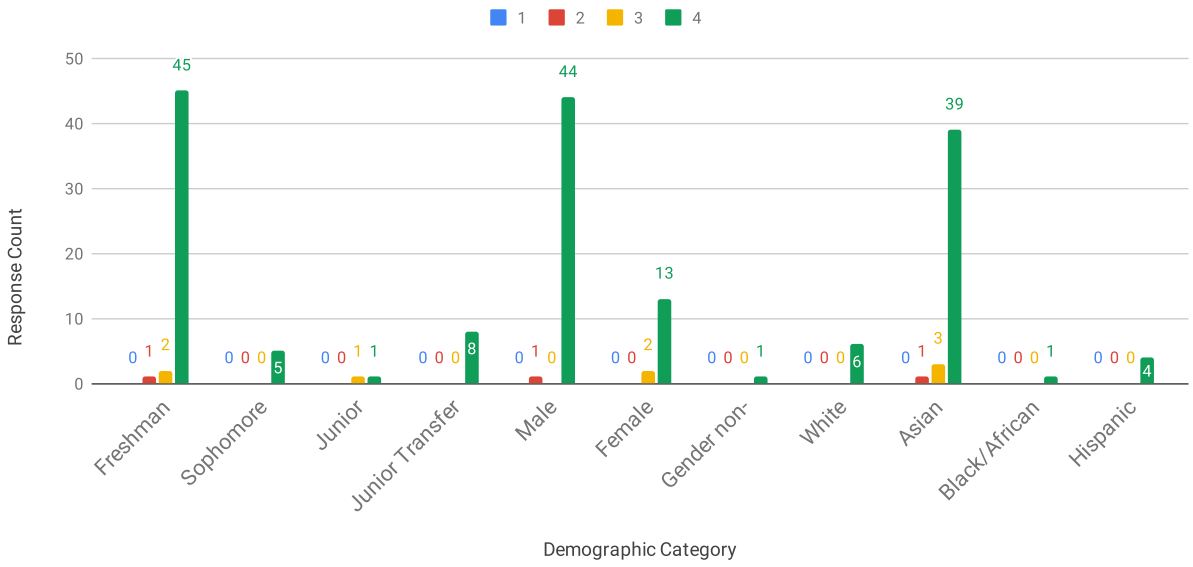

Figure A.2: Response count of students who interacted more than twice a week to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

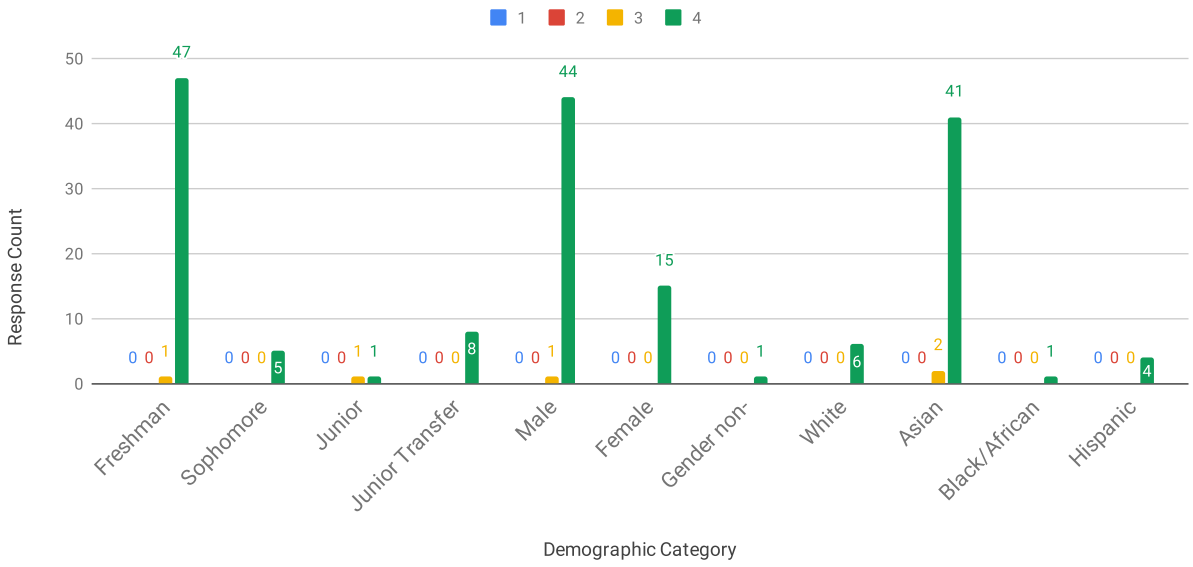

Figure A.3: Response count of students who interacted more than twice a week to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

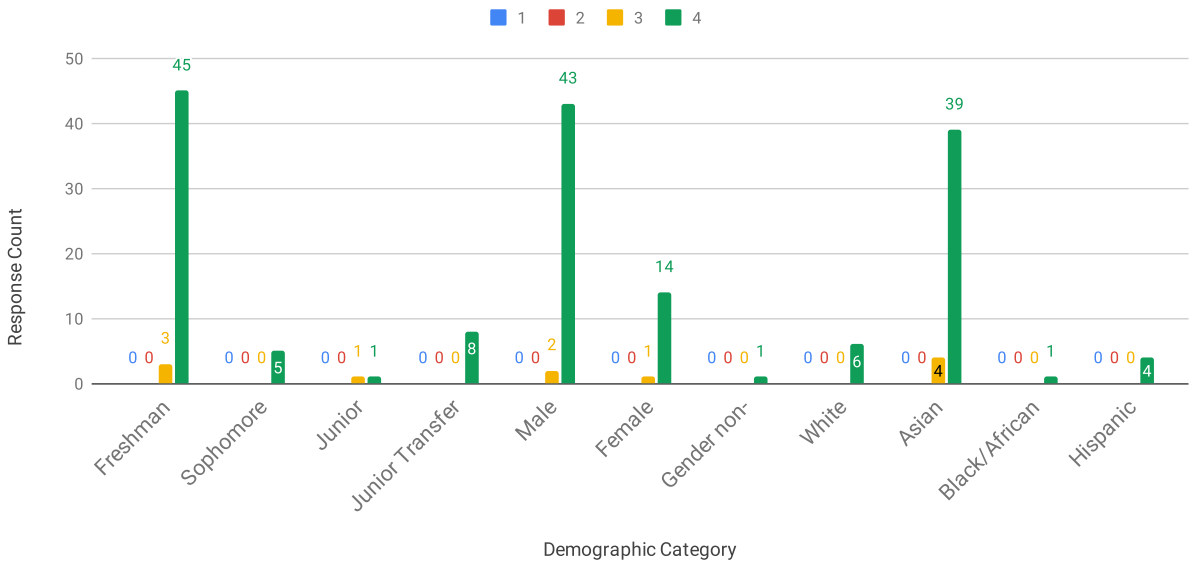

Figure A.4: Response count of students who interacted more than twice a week to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

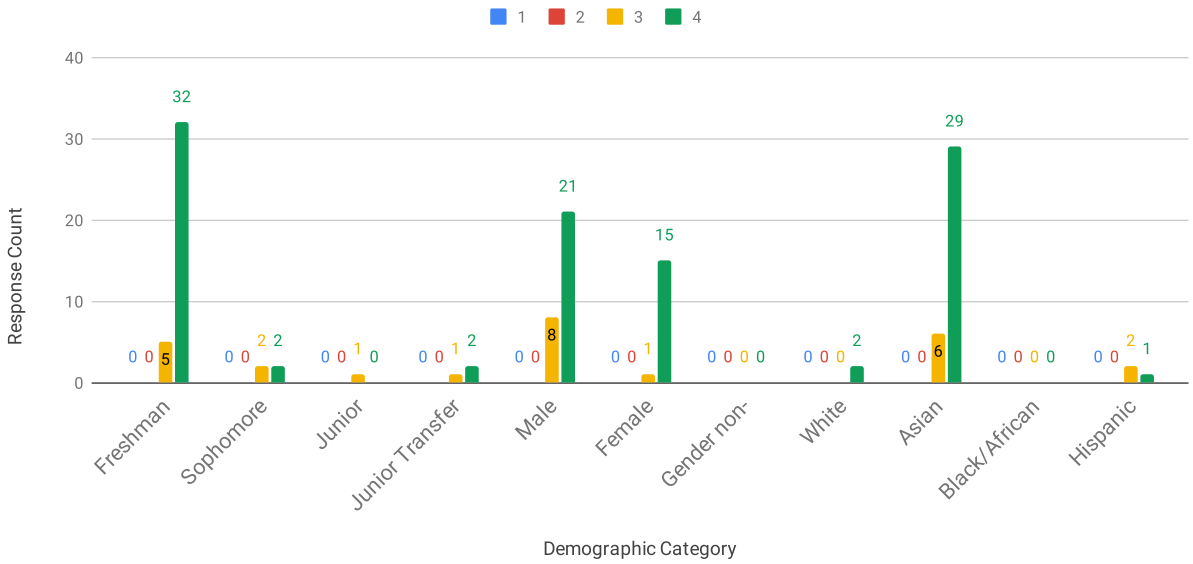

Figure A.5: Response count of students who interacted twice a week to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

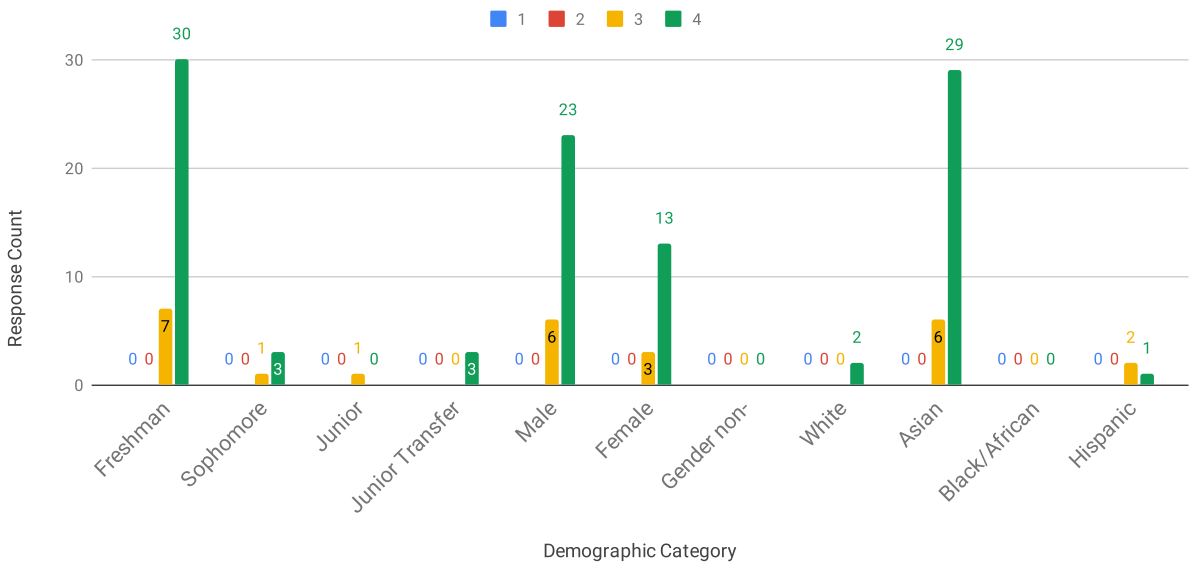

Figure A.6: Response count for students who interacted twice a week to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

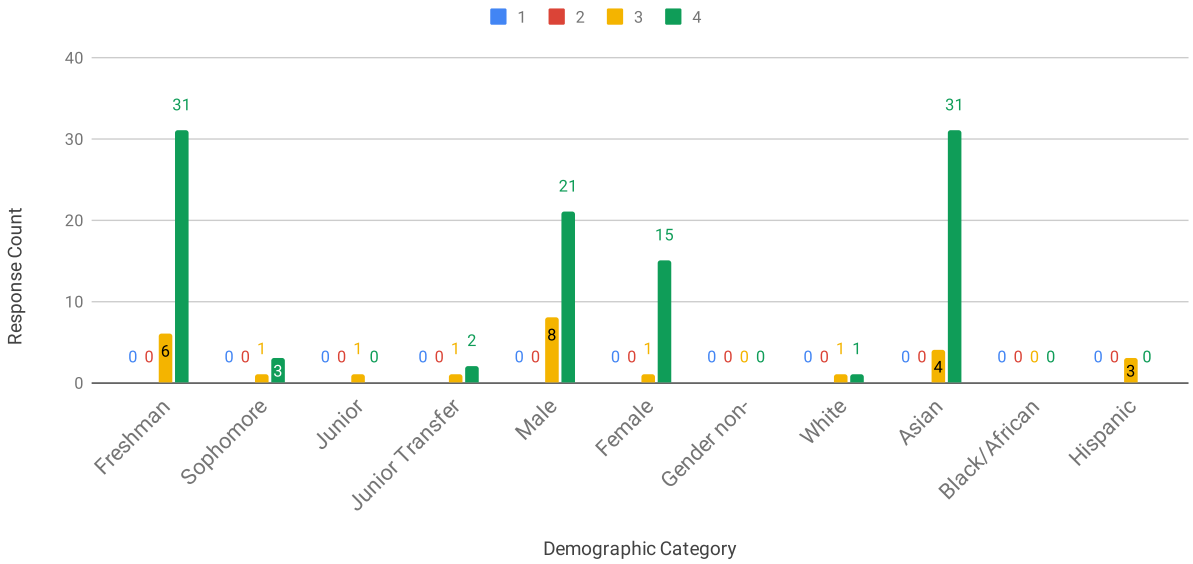

Figure A.7: Response count of students who interacted twice a week to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

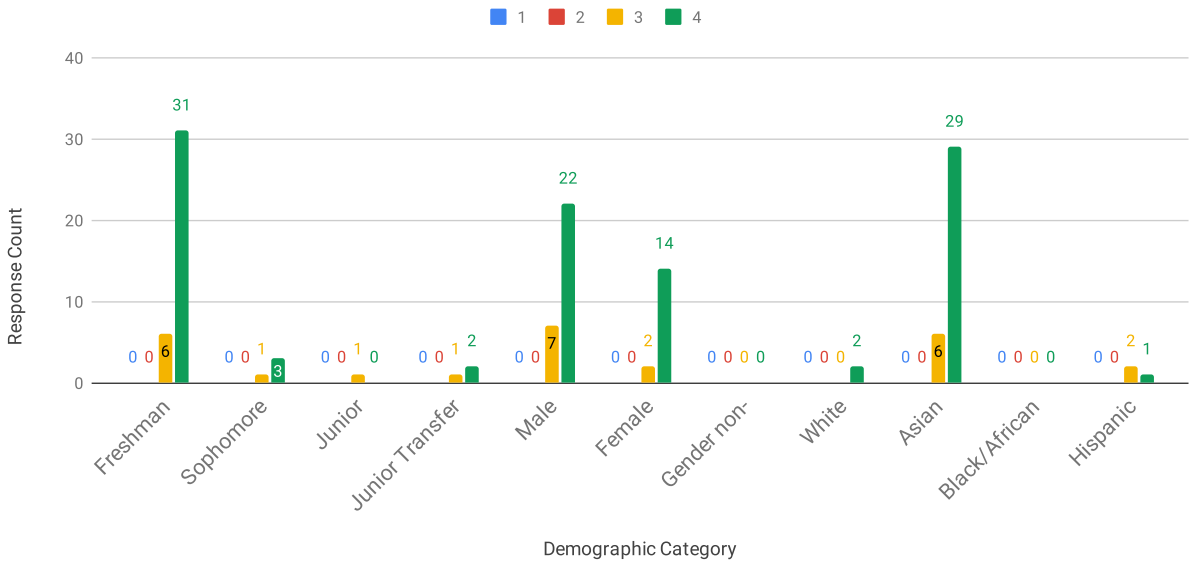

Figure A.8: Response count of students who interacted twice a week to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

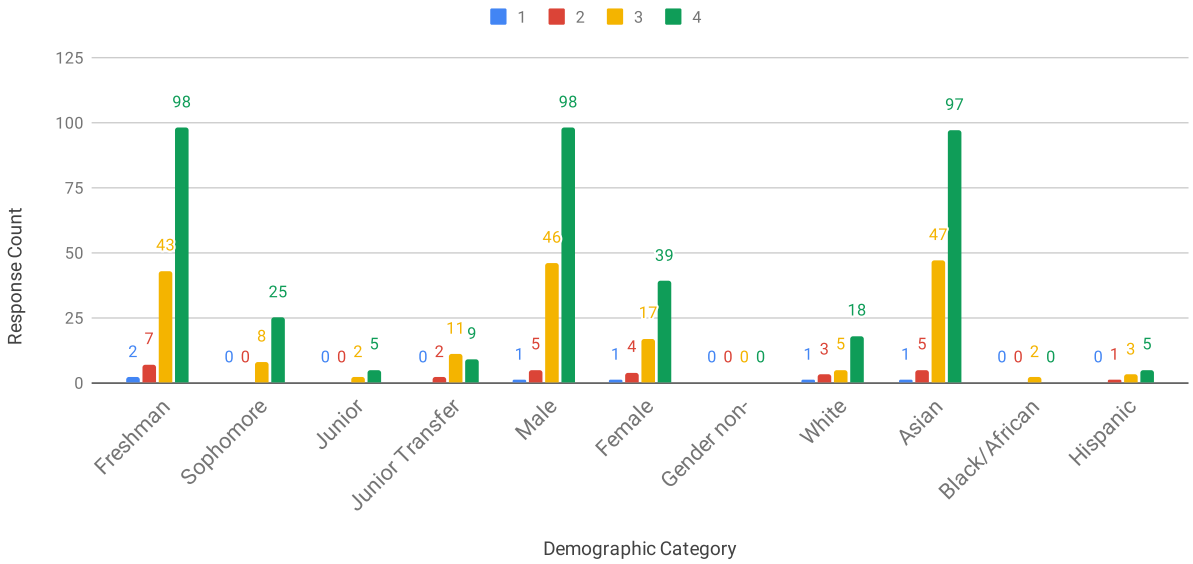

Figure A.9: Response count of students who interacted once a week to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

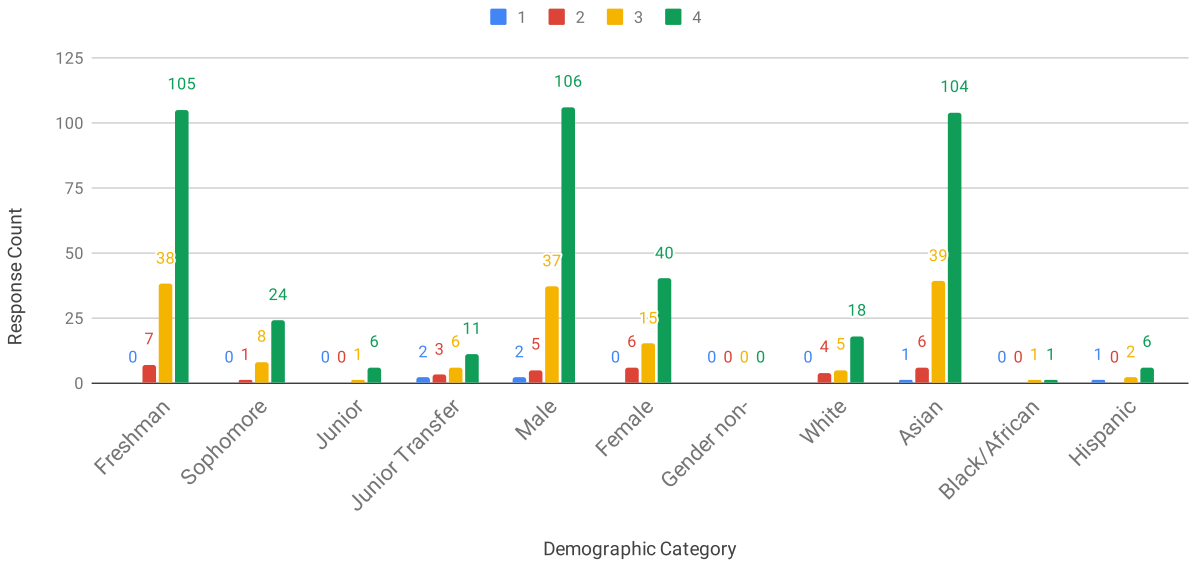

Figure A.10: Response count for students who interacted once a week to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

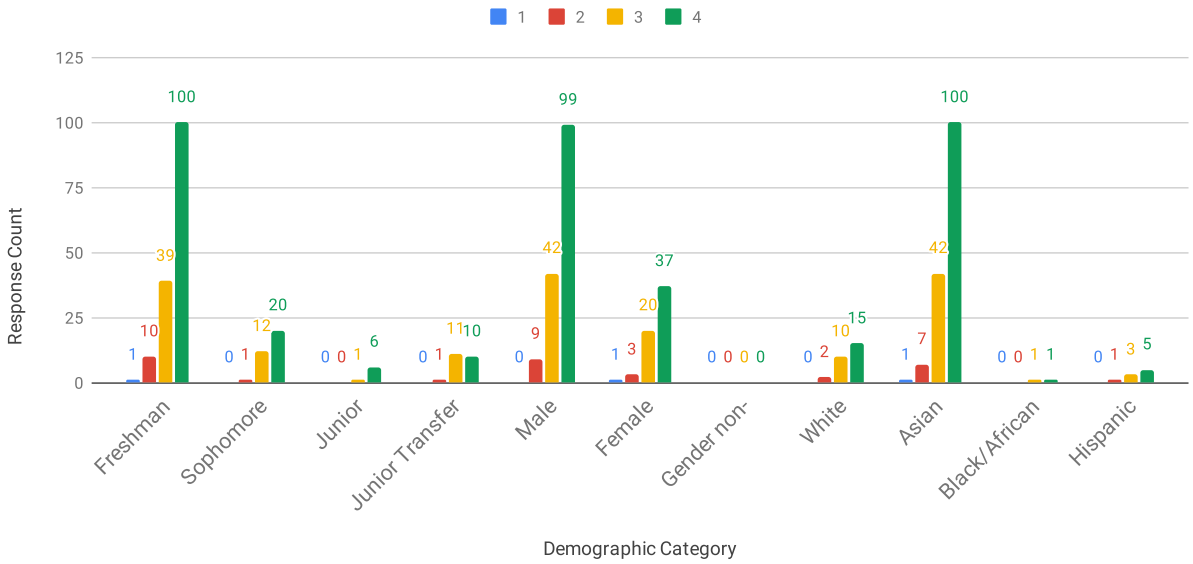

Figure A.11: Response count of students who interacted once a week to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

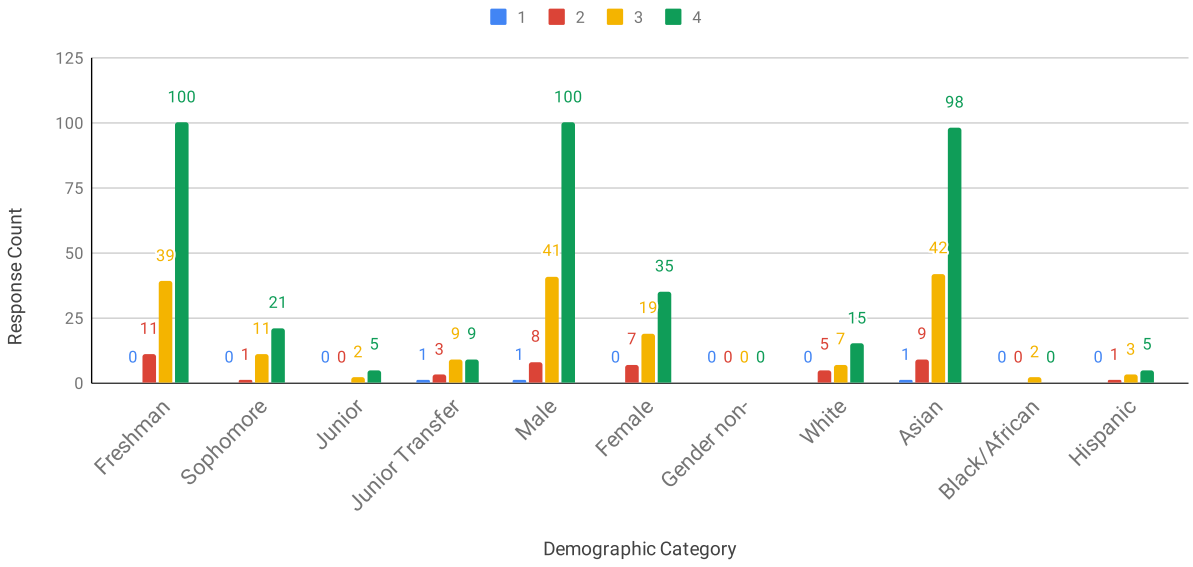

Figure A.12: Response count of students who interacted once a week to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

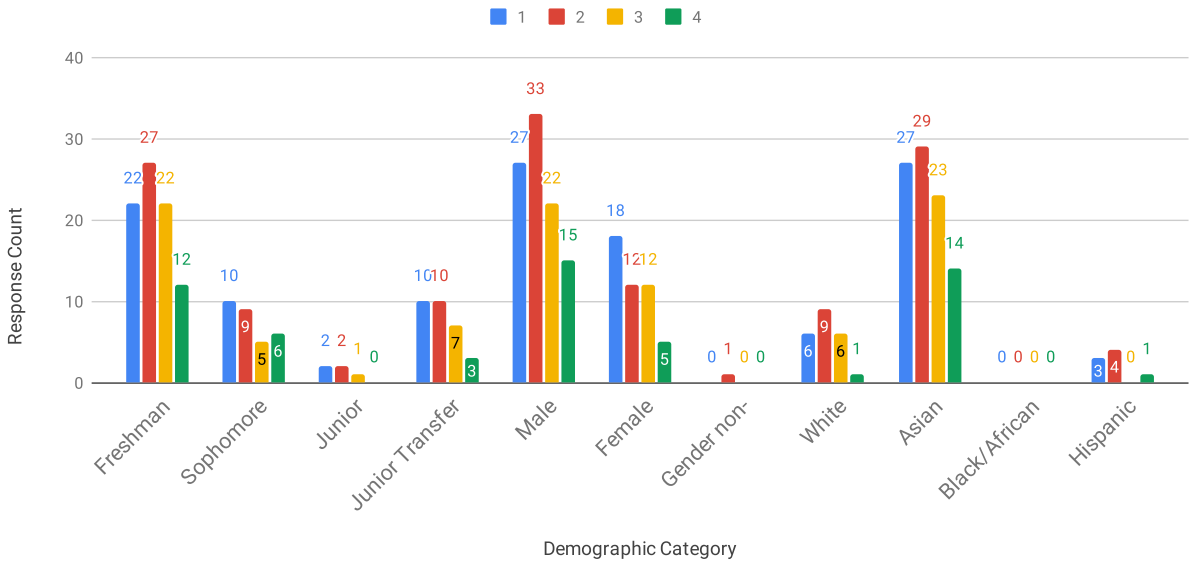

Figure A.13: Response count of students who never regularly interacted to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

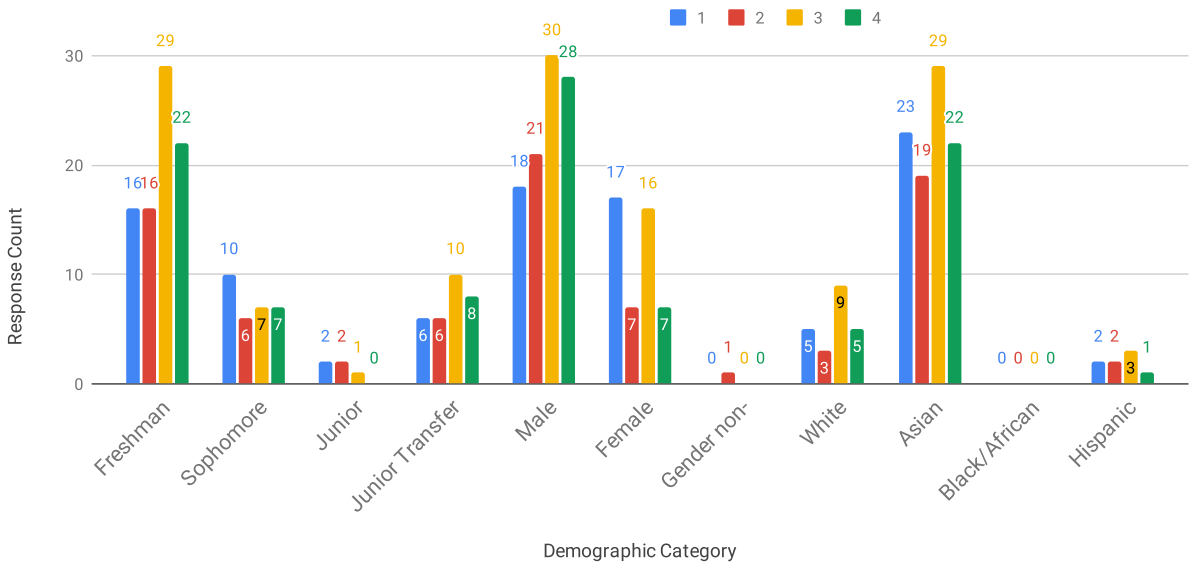

Figure A.14: Response count of students who never regularly interacted to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

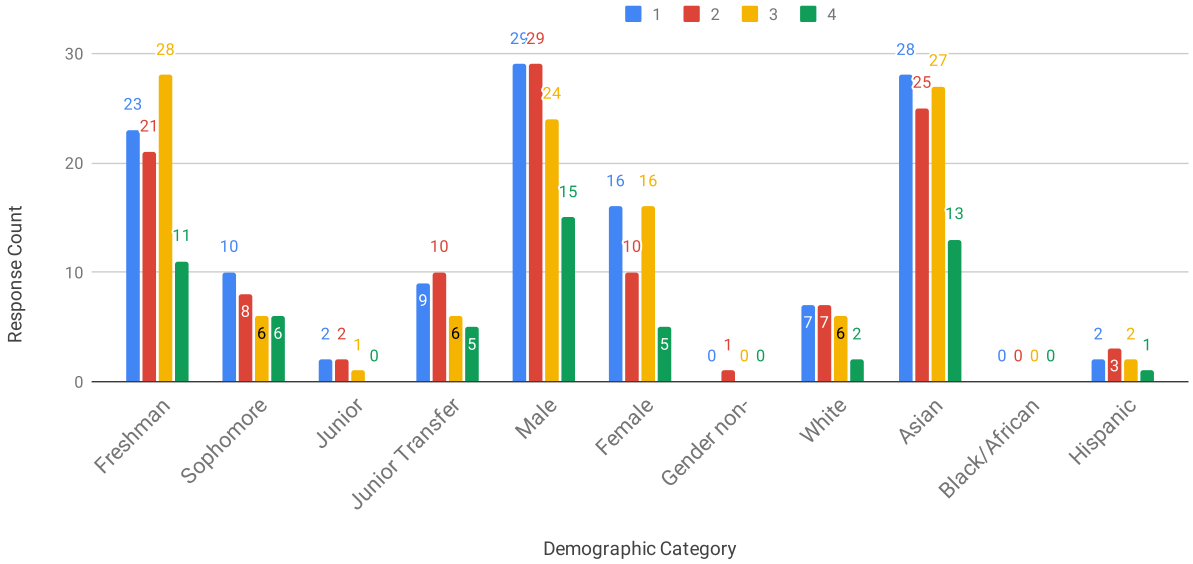

Figure A.15: Response count of students who never regularly interacted to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

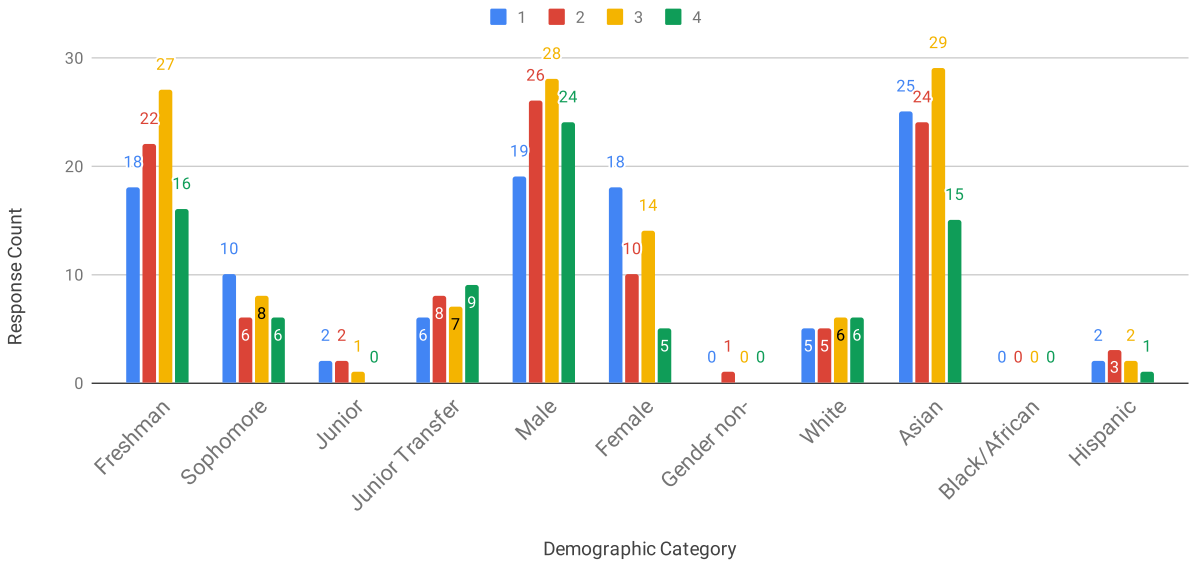

Figure A.16: Response count of students who never regularly interacted to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

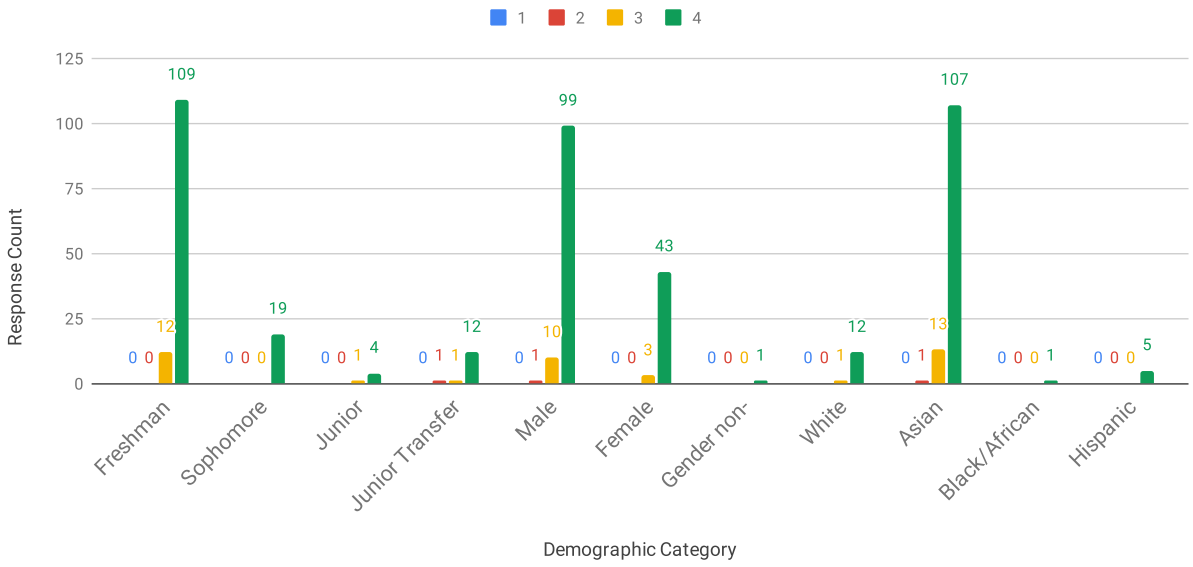

Figure A.17: Response count of students who said that everyone regularly participates to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

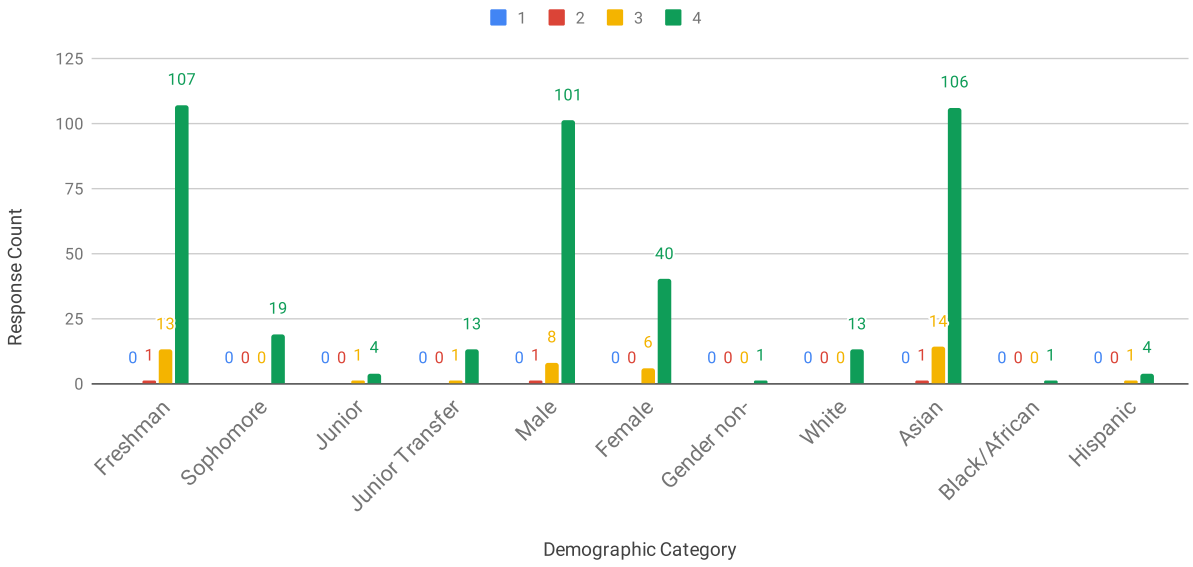

Figure A.18: Response count for students who said that everyone regularly participates to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

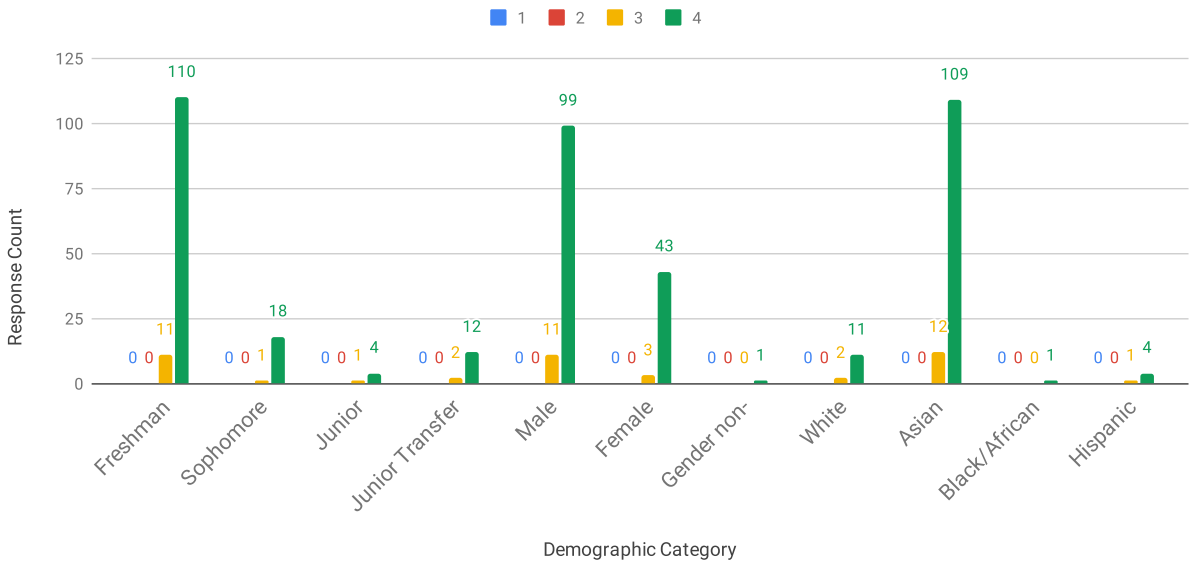

Figure A.19: Response count of students who said that everyone regularly participates to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

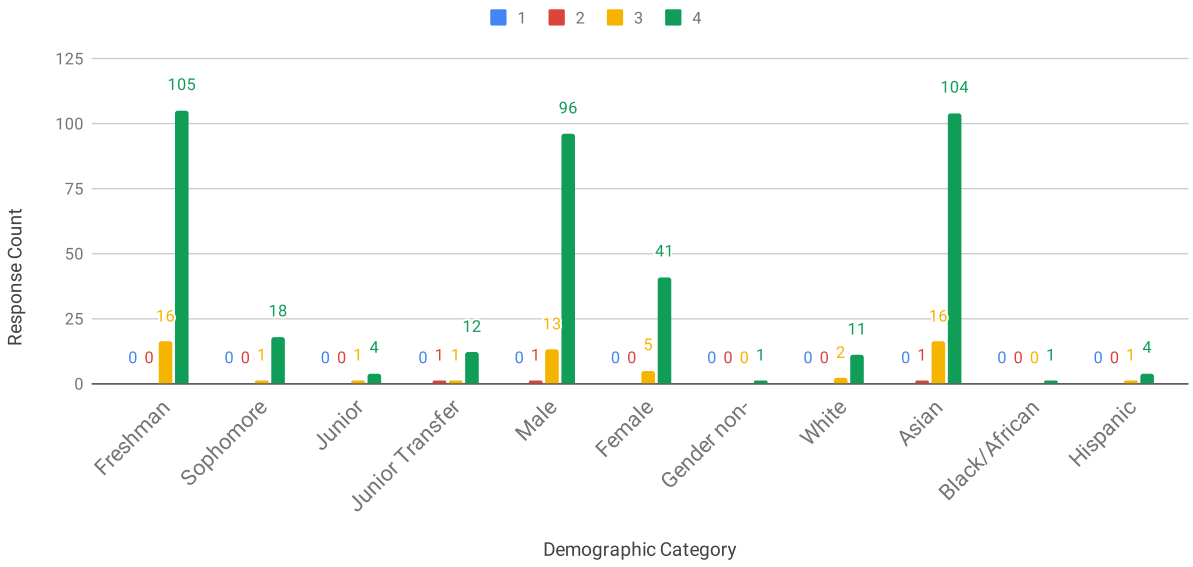

Figure A.20: Response count of students who said that everyone regularly participates to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

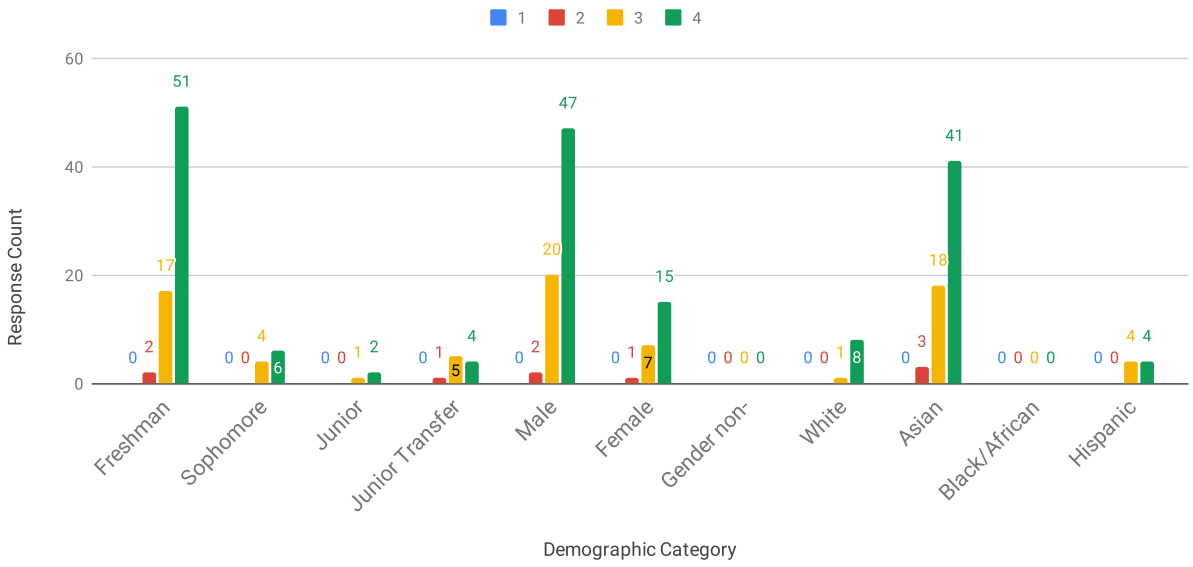

Figure A.21: Response count of students who said that most students regularly participate to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

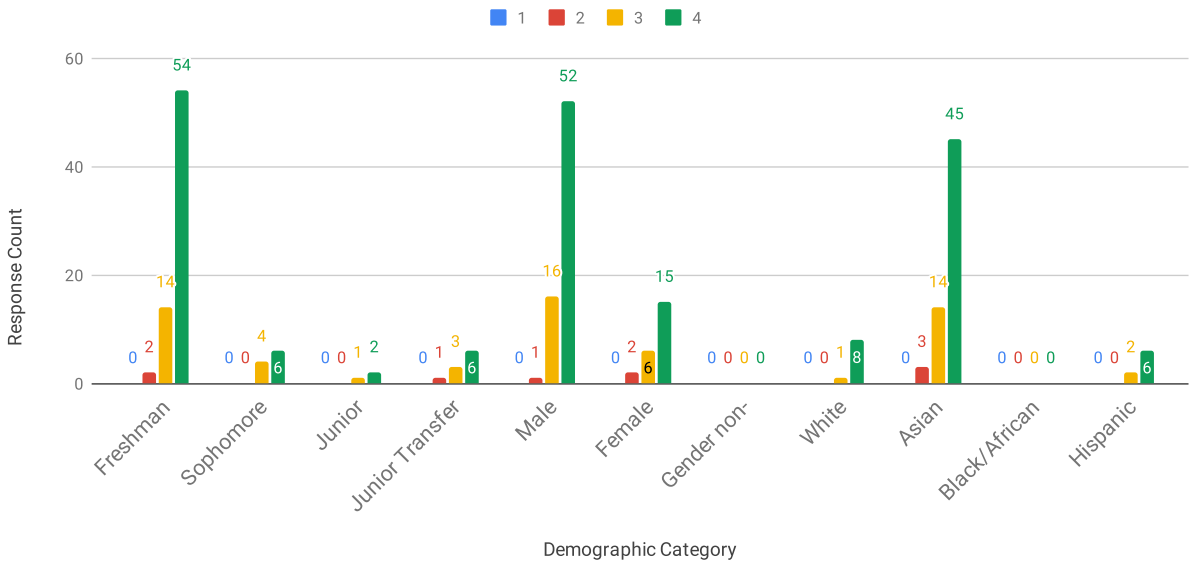

Figure A.22: Response count of students who said that most students regularly participate to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

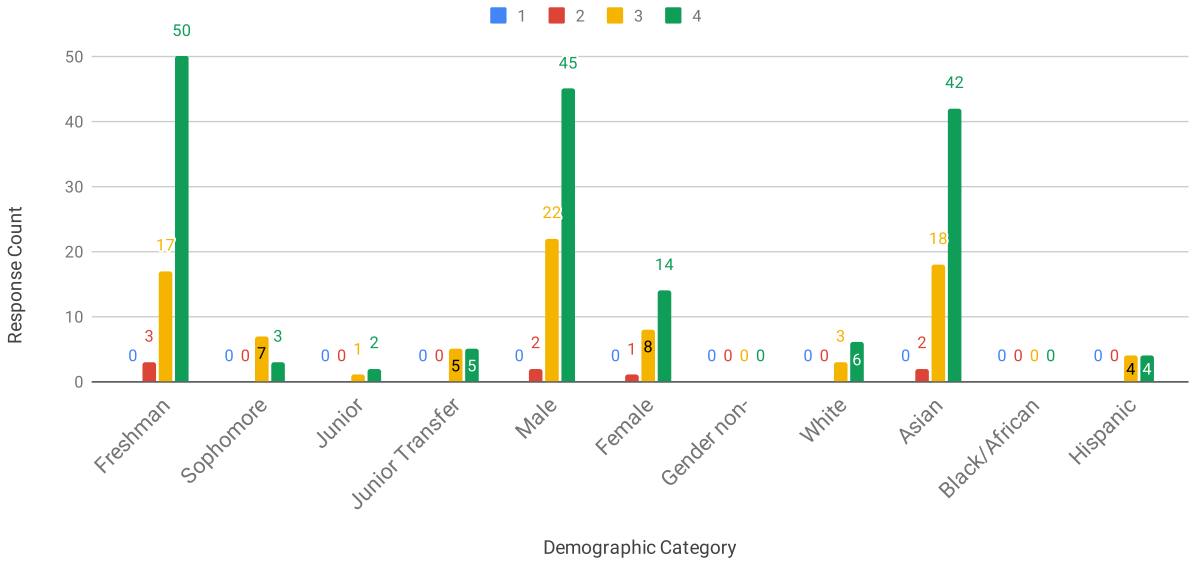

Figure A.23: Response count of students who said that most students regularly participate to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

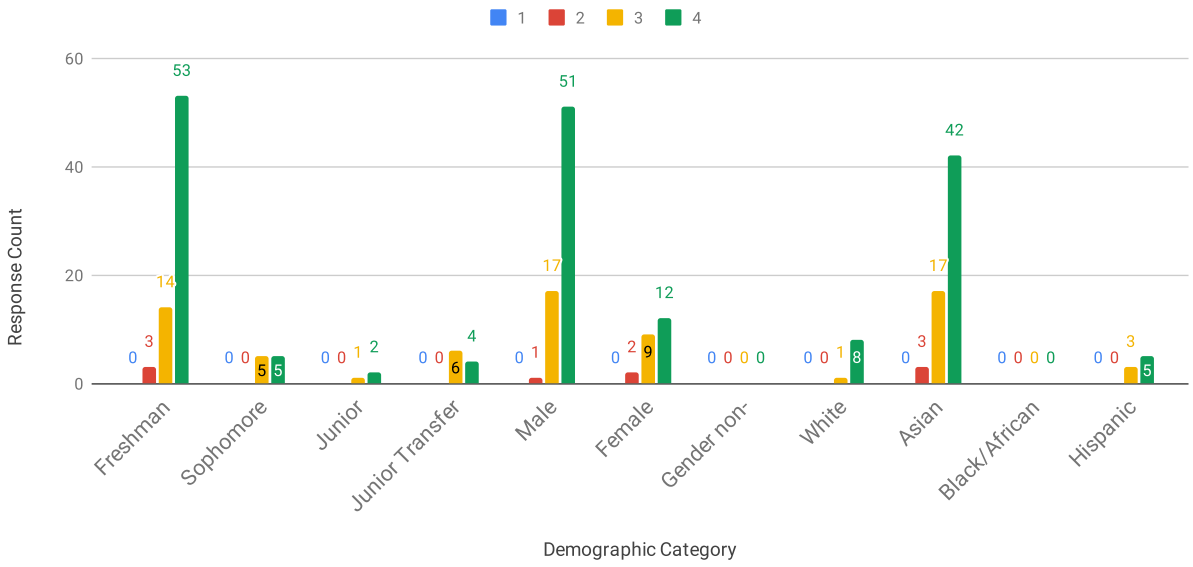

Figure A.24: Response count of students who said that most students regularly participate to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

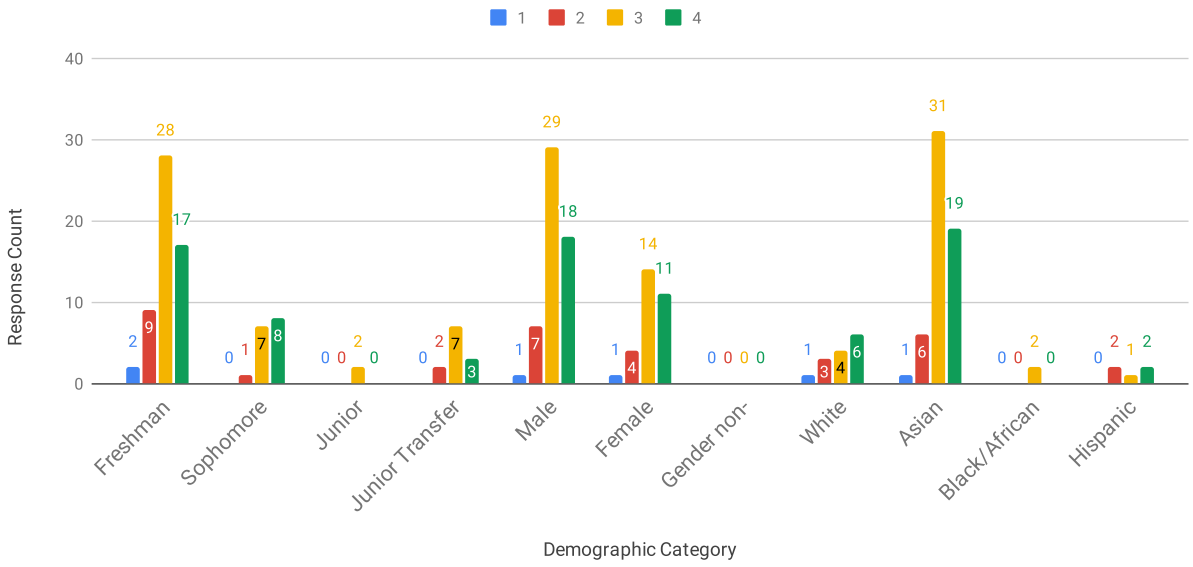

Figure A.25: Response count of students who said that some students regularly participate to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

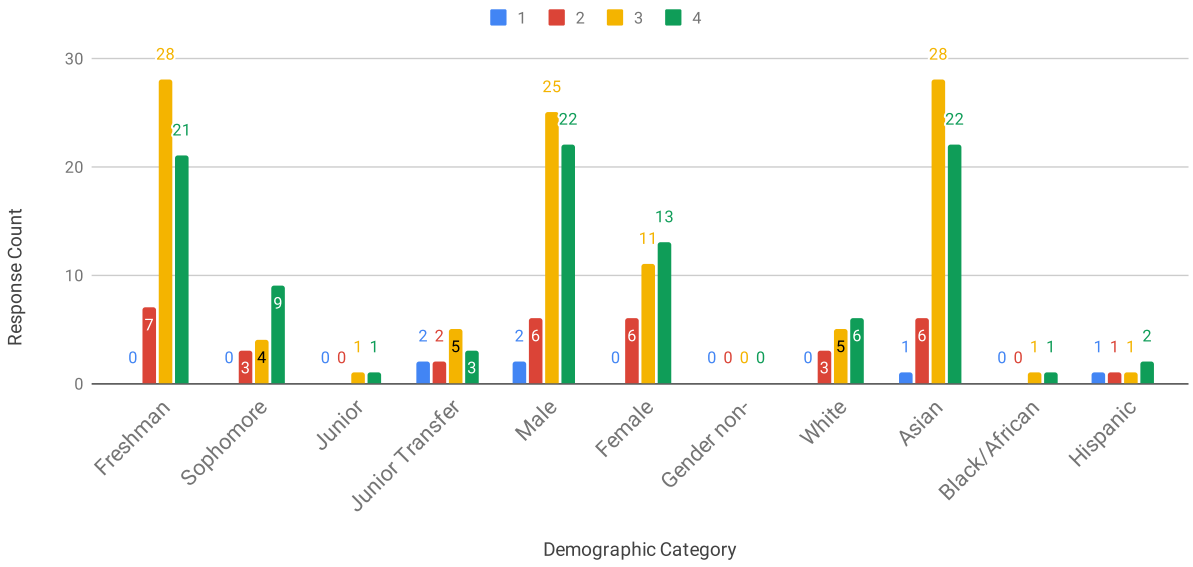

Figure A.26: Response count of students who said that some students regularly participate to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

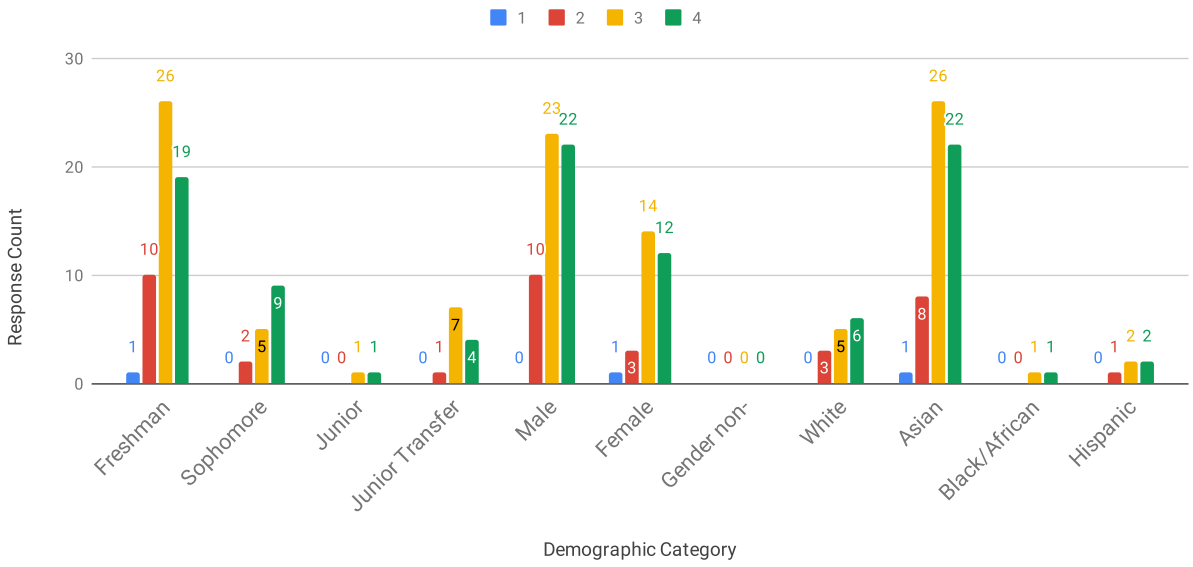

Figure A.27: Response count of students who said that some students regularly participate to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

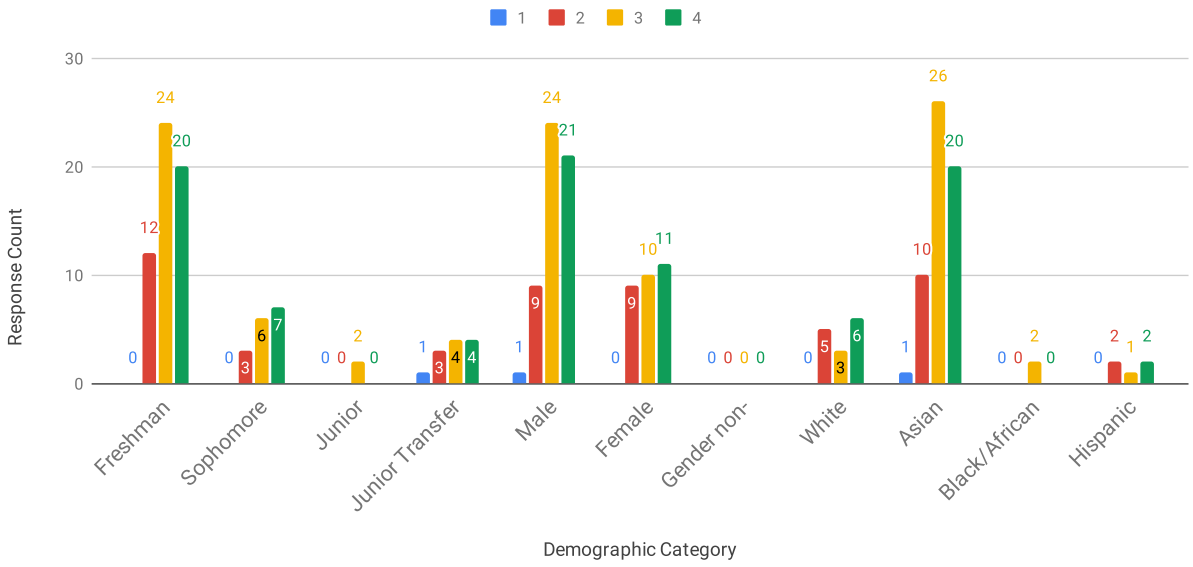

Figure A.28: Response count of students who said that some students regularly participate to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

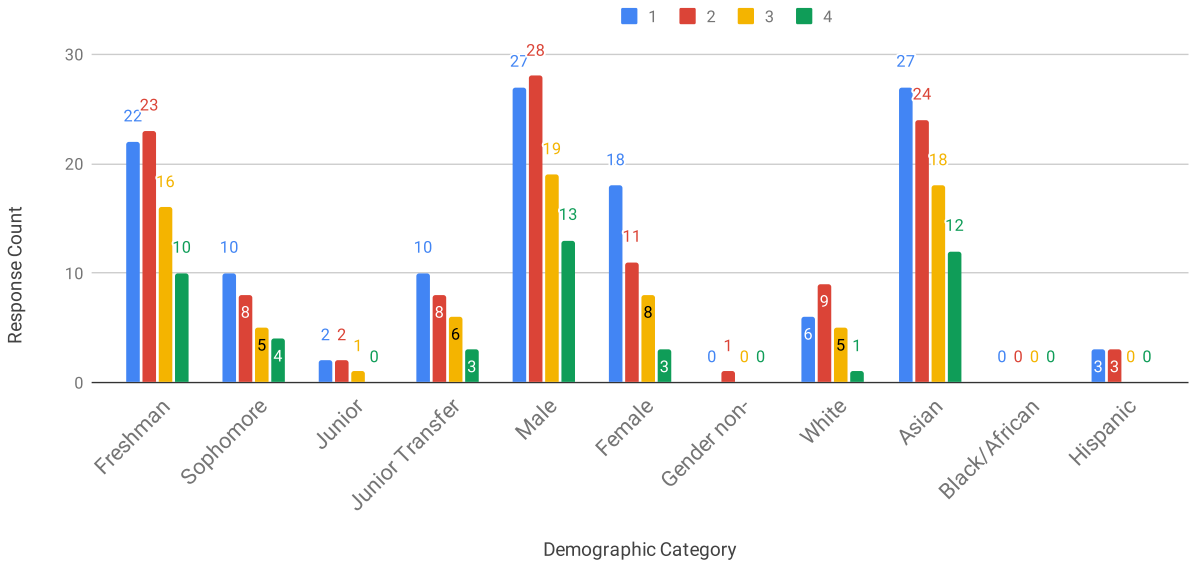

Figure A.29: Response count for students who said that no one regularly participates to question one "Do you think most people in your group are comfortable sharing ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

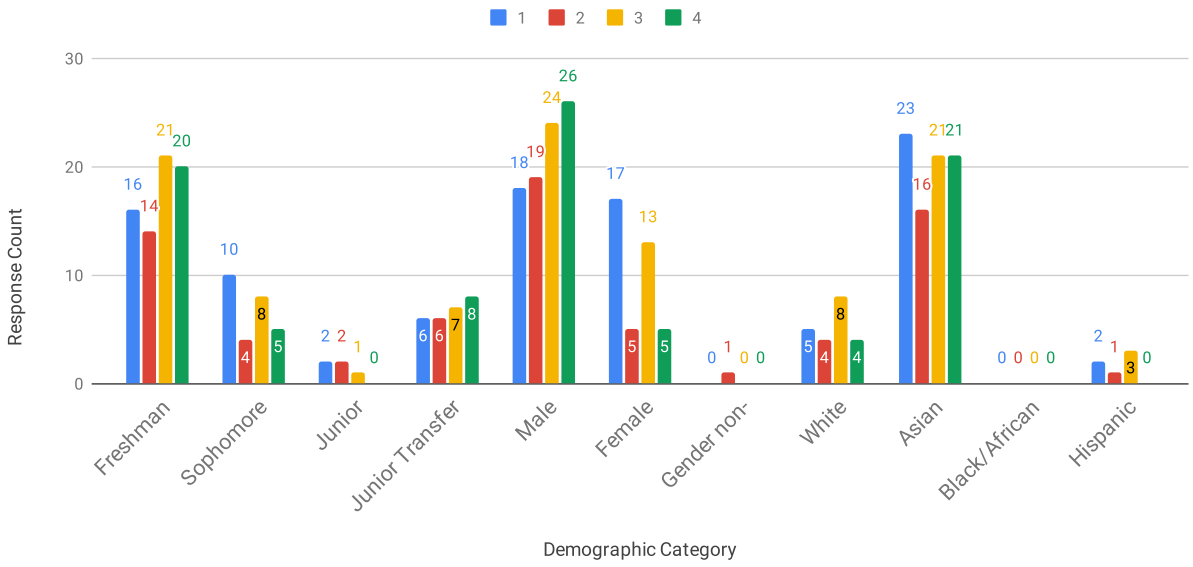

Figure A.30: Response count of students who said that no one regularly participates to question two "Are you comfortable sharing your ideas with the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates mostly uncomfortable.

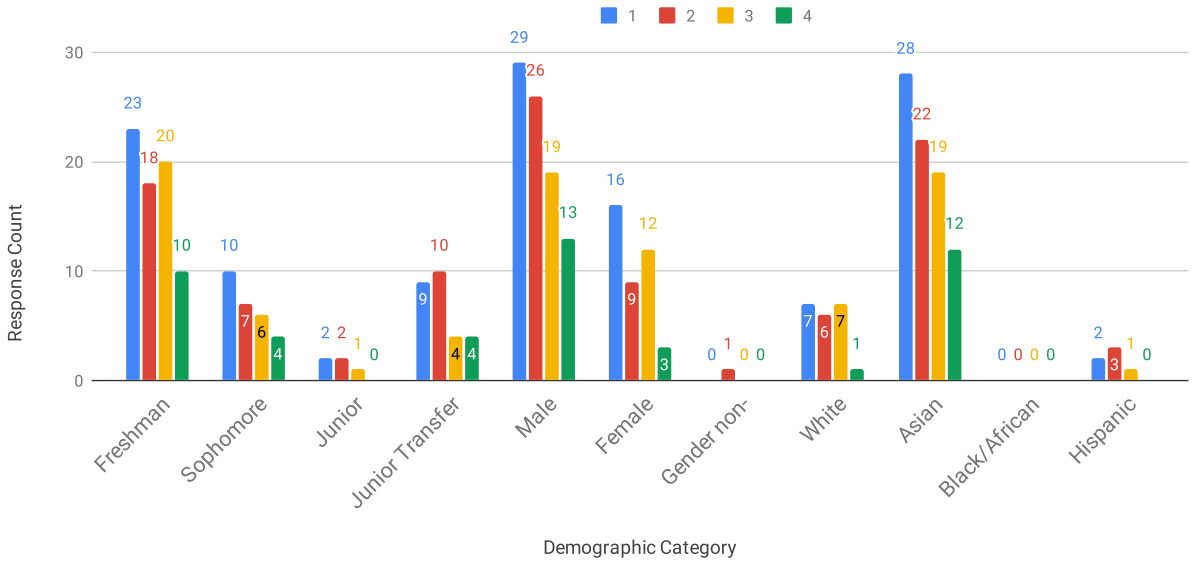

Figure A.31: Response count of students who said that no one regularly participates to question three "Do you think that most people in your group are comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.

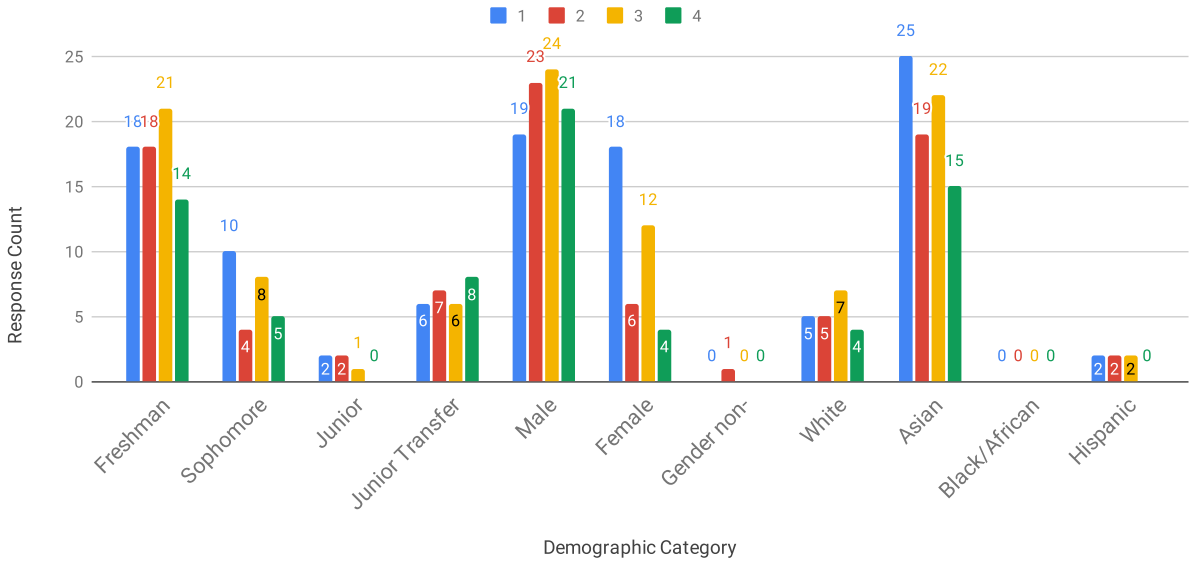

Figure A.32: Response count of students who said that no one regularly participates to question four "Are you comfortable asking questions in the group?" by demographic category. A response of 4 (Green) indicates mostly comfortable, while 1 (Blue) indicates not comfortable.