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Social and Cultural Barriers Reported by STEM International Graduate Students of Color

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ABSTRACT

This article explores international students' experiences in their graduate STEM programs at predominantly white US institutions through in-depth qualitative interviews and thematic analysis. International students reported encountering social and cultural barriers with American peers and sometimes even with other international students. These barriers include language, popular cultural, and social norms. Some students, who were less culturally represented in their cohorts, felt isolated but later found other people outside of their departments, often people from their same cultural background. The experiences of our participants varied by the representation of their culture in their departments, where students from less represented countries experienced more isolation. Connections to current acculturation theory will be discussed, as well as further implications and possible solutions for increasing intercultural exchanges.

Keywords: International Students, Cultural Barriers, Social Barriers, Intersectionality, Systemic Critical, STEM PhD, Students of Color.

INTRODUCTION

Over the past 50 years there has been a significant increase in the participation of international students in US higher education which has increased from 144,708 (1.6% of all enrollment) in 1970 to 1,075,495 (5.5% of all enrollment) as of 2020 (Israel & Batalova, 2021). In STEM programs, international students make up a large portion of earned doctorates, achieving 38% of all STEM PhDs in 2019 (National Center for Science and Engineering Statistics, 2020). International students are subject to the same challenges many immigrants face, often facing barriers not experienced by their domestic counterparts, especially when attending predominantly white institutions (PWIs). To better support international students in STEM graduate programs, their experiences in adapting and overcoming cultural and social barriers must be further examined, evaluated, and reported.

An array of cultural backgrounds are represented by international students pursuing their graduate education in the US, with the most represented countries being China (35%), India (12%), and South Korea (5%) (National Center for Science and Engineering Statistics, 2020). International student representation in STEM doctoral programs varies by subject, with engineering (57.2%), mathematics and computer science (56.4%), and physical and earth sciences (38.9%) having the highest representation of doctoral recipients (National Center for Science and Engineering Statistics, 2020). This is important to know to factor in what types of experiences a given student may have, since some may find it easier to find peers from similar cultural backgrounds within their courses. International students that come from less represented countries may have a harder time finding similar peers. Furthermore, since the demographics of international students varies by subject, student experiences may vary significantly by department.

International students face many challenges associated with adapting to the US during their studies (Andrade, 2006). International students may be subject to social, cultural, and racial barriers especially when attending PWIs. They may also face challenges related to visa restrictions (Hazen & Alberts, 2006), socio economic needs (Wilson et al., 2022), or inadequate student health care (Adegboyega et al., 2020). Most recently, international students dealt with COVID policies, including being required to enroll in at least one in-person course in order to remain in the US, a policy which disregarded their safety during the pandemic (Maleku et al., 2022).

This article will focus on the social and cultural barriers that international students face while pursuing their STEM degrees at PWIs in the US. In total, we interviewed 22 international students and asked about their experiences in their graduate STEM programs. These stories will answer the research questions below:

- (1) What cultural and social barriers do international students in STEM graduate programs experience?
- (2) What impact may cultural and social barriers have on international students?

Acculturation Theory

Adapting to a new country involves adapting to a different culture which has the potential to cause stress for those migrating, including international students. Acculturation refers to the process of adapting to a new culture (Brown & Zagefka, 2011). Acculturation is a multidimensional process where ethnicity, cultural similarity, and discrimination play a significant role in the experiences of migrants adapting to US society (Schwartz et al., 2010). In acculturation theory, there are four strategies for both immigrants and the larger society, depending on the maintenance of cultural identities and the relationships sought among groups of people (see *Figure 1: Acculturation Theory and Strategies*) (Sam & Berry, 2006).

Here is a figure highlighting the different dimensions and outcomes of acculturation theory.

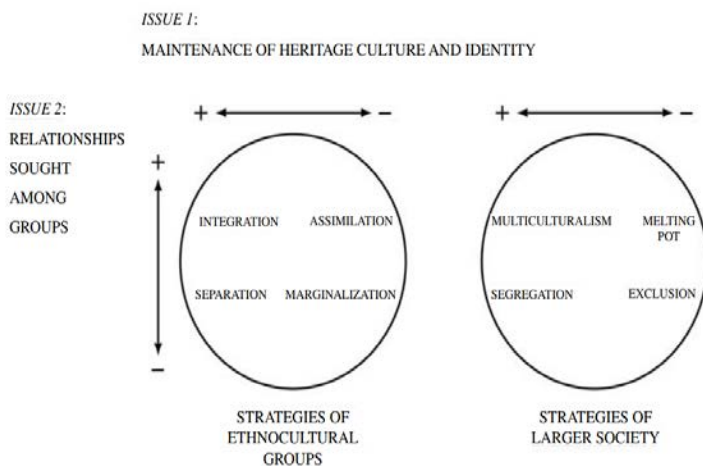


Figure 1: Acculturation Theory Strategies (Sam & Berry, 2006).

As seen in Figure 1, the acculturation strategies of those who are part of ethnocultural groups (i.e., international students) at PWIs may depend on two factors: (a) how much of their heritage and cultural identities they want to preserve, and (b) whether they decide to seek out relationships within the predominantly white society. Those who *integrate* into the larger US society find a way to hold on to their cultural identities while establishing relationships with American peers. Those who *assimilate* may lose some of their cultural identity as they establish cross-cultural relationships. Those who *separate* into culturally similar groups may establish less cross-cultural relationships but are likely to preserve their cultural identity. Lastly, those who choose neither to hold on to their cultural identity nor to mix with the larger US society, may end up *marginalized*.

The strategies of the larger society in Figure 1 are not dependent on individuals but rather on the groups that make up the society. When cultural groups of the larger society seek relationships with each other while preserving cultural

heritage, the result is *multiculturalism*. When cross-cultural relationships are sought out and some cultural heritage is lost in the process, this leads to a *melting pot* of the larger society. While *segregation* is when cultural groups don't interact with each other and instead preserve their cultural heritage. Lastly, groups that don't have cross-cultural relationships and don't preserve their cultural heritage, may face exclusion from the larger society.

Within acculturation theory, international students are *sojourners* since they voluntarily come to the US with the goal of graduating with specialized degrees. International students may be more welcomed by society as they are seen to benefit the country, whereas refugees and asylum seekers, as well as immigrants from lower socioeconomic brackets and those who immigrate illegally, may be less welcomed by society. While international students have agency to decide their strategies for socialization, the outcome is largely dependent on their environment. Integration and assimilation are more likely to occur in places characterized as multicultural or melting pots, which is unfortunately not the case for most PWIs. International students who easily find peers from their own background may find it easier to separate along with those peers, while international students from less represented backgrounds will have to assimilate, or worse yet, face marginalization. Since PWIs are less diverse spaces, there should be an emphasis placed on values associated with multiculturalism to facilitate integration among different groups of students. We will revisit this notion later in the manuscript.

Intersectionality

Another important theoretical framework to this work is *intersectionality* which considers the multiple identities international students may have. The term *intersectionality* was coined by Kimberly Crenshaw in her seminal work on racism and sexism which recognized how people have unique experiences based on multiple identities, as opposed to experiencing a mere combination of their different identities (Crenshaw, 2013). For example, a Black Muslim woman will have unique experiences that may not be understood by a Black Christian woman, or a Black Muslim man. International students may encounter challenges due to simultaneously having various identities such as race, religion, gender, and citizenship. Although intersectionality is not central to this work per se, we felt an explanation was warranted since this concept it is central to the experiences of our participants in this study.

METHODS

Data Collection and Analysis

The participants in this study were recruited from two predominantly white institutions (PWIs) in the Mountain West. The institutions selected were similar in size, research, and development funding, and both had medical schools. The researchers recruited participants through STEM-related graduate student organizations leading to 22 international students being interviewed across varying STEM majors. This first

round of interviews was conducted in the fall of 2020 and analyzed in the spring of 2021 by the first and third author. Then a second round of interviewing involving 17 of the 22 participants was completed in the fall of 2021 and analyzed in the spring of 2022 by the first and second author (see *Figure 2: Research Design*). Anonymized details about our participants' majors, genders, years, and degree levels for both interviews are provided in *Table 1: Anonymized Participant Information for Both Interviews*. The interview protocol is in the appendix. In *Figure 3: Anonymized Geographical Origin of Participants*, we provide a bar chart of the geographical locations students came from using United Nations (UN) definitions. In this study, we report on the experiences of the 22 international students recruited. All the interviews were recorded through one on one 30- to 90-minute online video meetings using a semi-structured interview protocol. The audio from the interviews were professionally transcribed for analysis. The transcripts were coded by means of computer assisted qualitative data analysis using RQDA (Huang, 2016) and R using a thematic analysis approach (Boyatzis, 1998) with influences from grounded theory methods (Charmaz, 2006).

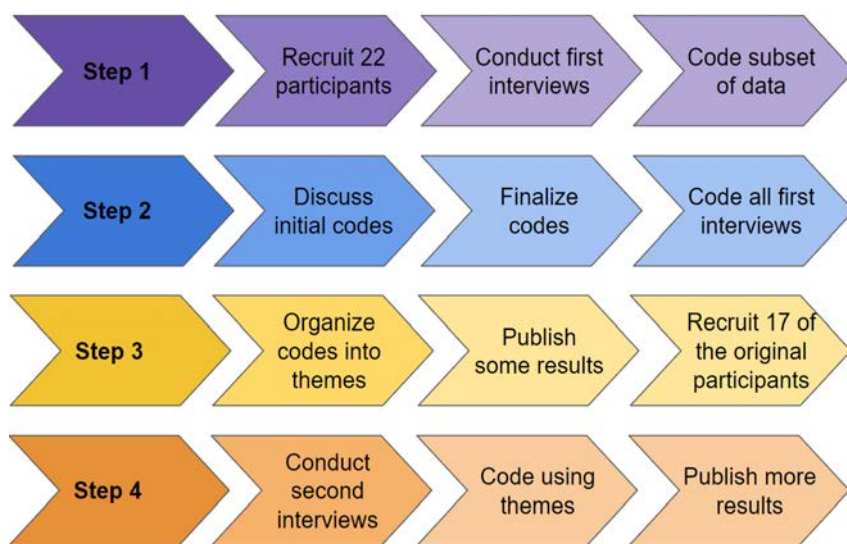


Figure 2: Research Design.

Here is a flow chart of our research design including the data collection and analysis.

Here are anonymized details of our participants for the first interview in the fall of 2020 and the second interview in the fall of 2021.

Table 1: Anonymized Participant Information for Both Interviews.

Major	2020	2021	Year	2020	2021	Gender	2020	2021
Computer Science	16	11	1st	6	4	Male	13	10
Math	3	3	2nd	7	5	Female	9	7
Physics	1	1	3rd	3	3	Degree	2020	2021
Chemistry	1	1	4th	2	1	MS	9	5
Biology	1	1	5th or more	4	4	PhD	13	12

Here are the details of our participants geographical origin for the first interview in fall 2020 and the second interview in the fall of 2021.

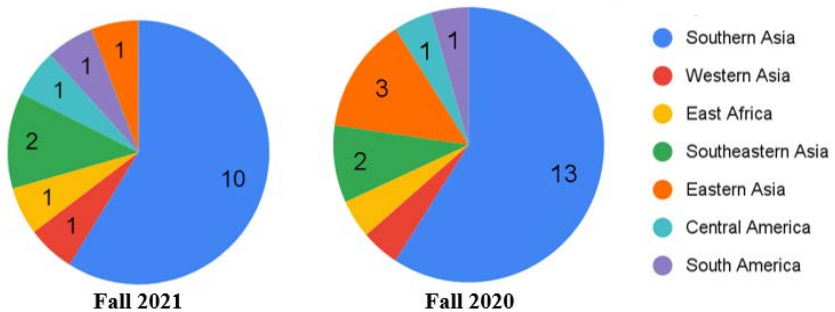


Figure 3: Anonymized Geographical Origin of Participants.

For the initial analysis of the first interview, a subset of 9 students was made and coded independently by the first and third authors. Once both researchers finished coding the same 9 participants, the codes were discussed and agreed upon by both researchers leading to a final set of codes. The final codes for Interview 1 were also operationalized, meaning both researchers agreed upon how the codes would be employed. Then both researchers went through all 22 participant transcripts for Interview 1 with the final codes, allowing us to ground our analysis in the experiences of the participants. Each researcher wrote memo notes for each participant along the way, allowing for further comparison of the participants among the researchers. Once coded, the authors found themes across the participants and among various topics. The results were themes that reflect the experiences participants shared with us, which were further discussed among the researchers to check ideas. While some of these results have been submitted for publication, other results sparked additional questions which led us to conduct a second round of interviews. We were able to recruit 17 of the original 22 students, and we coded their second interviews using the themes we had already established in Interview 1. This process was straightforward since we created the second interview protocol based on asking the participants about these specific themes. This article will focus on the themes of *cultural barriers*, *isolation and segregation*, and *cross-cultural interactions*.

Positionality and Ethical Considerations

The first author of the paper identifies as an Afro Hispanic Puerto Rican Agnostic cis het man who grew up and lives in South Florida around communities including many cultural backgrounds and identities. The second author identifies as an Egyptian Muslim cis het woman who grew up in Alexandria, Egypt and has attended a predominantly white university in the United States since 2019. The third author is a Mexican Puerto Rican cisgender heterodemisexual man born and raised in the borderland between Mexico and the United States. The fourth author identifies as a Hispanic Atheist queer man who grew up in Michigan and currently works at a PWI but participates in multicultural communities. Our mixed identities allowed us some insight into the unique and varied personalities of our participants; however, we had to continually reflect on and discuss our identities to ensure a robust and thoughtful research process. It should also be noted that the senior authors are domestic to the United States and, as a result, there may have been some oversight as we attempted to identify relevant international experiences.

Ethical considerations were at the center of this work, including building out a protocol to protect participant anonymity and compensating participants for their time. Often times research participants are asked to participate with no support. Many of our participant students worked as teaching and research assistants to support their lives and may have had additional responsibilities such as caring for a family member. To recognize their generous contribution of time participants were offered an online gift card. Each participant also had the opportunity to review a consent letter and ask questions to the interviewer both before and during the interview. Further, this study was reviewed and overseen by the University of Utah Institutional Review Board to ensure we followed all policies, procedures, and laws regarding research with human subjects.

RESULTS

Two main themes related to the topic of culture emerged from analyzing participant racialized experiences: *Cultural Barriers*, and *Isolation & Segregation*. The first theme identified was *Cultural Barriers* which included English proficiency, knowledge of popular culture, and other social norms such as cultural gesture differences. The second and most shared theme overall was *Isolation & Segregation*. Many students reported feeling isolated in the beginning of their graduate STEM programs, and many later formed social groups often composed of people from their same cultural background. The contrast of diversity in academia and homogeneity in non-academic social spaces was evident from most of the students' experiences. The final theme that came up was related to the *cross-cultural interactions* our participants reported. Some participants were able to cross cultural barriers and make friends with peers from other cultural identities, while others reported conflict with peers from different cultural groups.

Cultural Barriers

Many of our participants reported facing different types of cultural barriers during their graduate STEM programs. Several participants expressed the English language as being a hurdle, both academically and socially. Even participants with fluent proficiency in English have non-American accents which led to complaints from students. Other participants noted popular culture differences creating challenges when trying to converse with American people. Finally, other international students reported that differences in social norms, such as gestures, made it more difficult for them to socialize with Americans.

English Barriers

For most international students, English is not their first language, and therefore it may require extra effort and work for them to read, listen, and write during their coursework and research. Amin, explains how he struggles with long reading assignments:

For example, 20 pages or 25 pages takes me at least one day to read. But, for you, maybe, in the professor's view, it's only two hours, but that's difficult for me. Maybe they say their view is that when you come here and say, "I have passed an English test," you have to be able to read them. Yeah, I can read, but the speed is different ... If my English was better, I think it would be easier. (Amin, Interview 1)

Amin makes it clear that passing English tests, such as the TOEFL and the IELTS, does not mean his proficiency is at the level of a native English speaker. This means Amin needs to invest more time in reading than a native English-speaking person. During Interview 1, Amin also mentioned that he reads all the emails sent from the university since he doesn't know how to distinguish the importance of each of them. International students may feel an extra burden of having to read through all their emails or having to complete long reading assignments at a slow reading pace. Hope, Smith, and Rodrigo also voiced struggles with English. Here Smith mentions his struggles in listening and understanding English:

The biggest thing is the language problem because I'm not good at English so I cannot interact with other people. When I studied in a university in [my country], I could speak and understand anything without any problem. But here I'm studying in English, and I need to see the class videos more than one time because sometimes I can't understand what the professor said and what is the meaning. (Smith, Interview 1)

Smith struggles with listening and speaking English which limits his social interactions with others. Additionally, he mentioned how he didn't have the opportunity to speak English, outside of watching class videos, due to the pandemic social distancing protocols. Since he didn't interact with many people in English, he spent his time speaking another language with his wife, child, and their friends. Other participants also mentioned how COVID restrictions greatly limited the progression of their English language development.

Even our participants that were fluent in English received complaints related

to their accent. Michael and Faiz both mentioned how students in their classrooms complained that they couldn't understand them, Faiz goes on to say:

So, when I'm teaching, it's more or less a pretty conventional type of lecture. So, I try to make sure that I'm as clear English-wise as I can be. But in the feedback or conversations with students, no matter how hard I try, some of the students feel like I have a very thick accent and can't really understand what I'm saying, and I don't know how to help that. (Faiz, Interview 2)

Even though Faiz is highly proficient in English, his accent is a common complaint among his students. Students also complain about Faiz's accent on their end-of-semester evaluations, which often resulted in lower teaching scores for Faiz. Faiz mentioned how he is working hard to "fix" his accent but that it's difficult for him to do so, especially after speaking English this way for many years. Faiz's experience could indicate a lack of tolerance towards different accents at PWIs. This topic will be discussed in more depth later in the manuscript.

Popular Culture and Social Norms

US popular culture and unfamiliar social norms may present challenges for international students. Many of our participants reported challenges when interacting with American peers in social situations. Ngo explains:

Well, it's definitely hard to talk to people sometimes because we're just different in culture. Americans talk about things I don't really understand. They go to bars and stuff, whereas [people from a different culture] like me usually are very reserved. We usually stay at home, we don't go to bars, so we have less experience I suppose. So, in a conversation, they have a lot of things to talk about, I just don't. It's kind of sad. (Ngo, Interview 2)

Ngo explains how he doesn't understand what Americans are talking about when he talks to them. He also mentions how they go to bars, but he doesn't go since he is more reserved. Several of our participants expressed that they don't drink alcohol which resulted in them choosing to not attend social gatherings involving the alcohol. Ngo also expressed being "afraid to ask questions that may offend people, that might be considered to be prying into their lives." This fear of asking personal questions due to cultural contextual differences was commonly expressed among our participants. Blue discussed how challenging this could be as well:

I'm from [another country] and people here are Americans, and I still struggle to get into conversations, to jump into conversations, because half the time they're talking about something very American and I don't know about it, so how would I even jump into conversations like that? (Blue, Interview 1)

It's difficult to navigate social interactions under a different cultural context than your own since popular culture is culture dependent. Blue's sentiments here are representative of social cultural barriers that our international participants experienced during social interactions with Americans or people of other cultural backgrounds.

Gestural social norms also present cultural barriers for international students. Michael mentions:

Something funny happens here, people give you a smile or two just out of respect. People don't do that in [other countries]. So, me and my friends would think "What's going on? Why did they smile at me?" That was something. (Michael, Interview 1)

Michael had to get used to receiving random smiles as a basic form of greeting, which is not the social norm in his country. A simple smile may be taken in different ways and is culturally dependent. Other gestures, such as how an individual eats, is also culture-context specific and therefore may also present social barriers. Faiz recalled his hesitation to eat with Americans due to his use of hands to eat:

It's very small things, for example, if I sit and eat with them, I'll eat with my hands. I won't use spoons. It's the way I've grown up. They would prefer to use a fork and knife, which is completely fine, which is the way they've grown up, but then, it can possibly get uncomfortable for them, or at least for them to say they'll be probably more comfortable if everyone is using forks. (Faiz, Interview 1)

As a result of not wanting to make others feel uncomfortable, Faiz prefers not to eat with American people since he doesn't use a fork and knife. He acknowledged that it was a small thing but made it clear that the issue of eating was only one example of several other small differences in social norms.

Differences in popular culture were not confined to social interactions with peers but also took place with professors. Sometimes professors use language that is heavily dependent on cultural context. Here Smith recalls such a situation:

The professor mentioned some kind of phrase I think every American can understand, but every international student can't. I'd like to share actually... [looks for class notes] 'Is it sunny in Yuma?' I think most Americans can understand because they know where Yuma is. When I heard this word, I panicked and asked myself why Yuma? Where's Yuma? That kind of thing is a little hard to understand and I think this is American culture, some American jokes, I think. (Smith, Interview 2)

Sometimes professors say American phrases that are hard for international students to understand since the students don't have the cultural context necessary for comprehension. In this case, Smith spent time looking up the phrase, thinking that it was important, which temporarily distracted him from the coursework.

There may also be implicit norms that professors may expect from their students that are often not explicitly communicated from the beginning. Abe reports having such an experience when he taught a course in cybersecurity:

That's really the first time I felt the cultural background gap thing because there was one professor of mine, he was decent and good, but whatever job he used to give us, I used to do it on time, not bragging on my end. Then we had something like a midterm review and my graduate advisor told me that 'your professor says you are not proactive' and it was shocking for me because I was doing everything asked for. (Abe, Interview 1)

Abe served as a teaching assistant, and the professor he worked for had expectations beyond what Abe was aware of. Therefore, although Abe did everything the professor asked, Abe did not receive full marks on his teaching review. Based on the experiences of our participants, Abe's experience was not an isolated incident. Faiz and Faith reported similar implicit expectations they were not aware of until faculty complained. These problems are often rooted in a lack of communication of

what is implicitly expected from graduate students.

Isolation and Segregation

Many of our international participants reported some form of social isolation or segregation during their graduate studies. Participants who were the only people of their own ethnicity and gender in their programs reported experiencing isolation. Conversely, participants who were more represented in their graduate programs more easily connected with their peers socially. Many of our participants reported having personal social circles with people from their own cultural background. Some students reported looking for people from their own cultural spaces purposefully, while others said they tried befriending American peers but were unable. It may be that the cultural barriers presented above led to the experiences of isolation and segregation discussed below.

Isolation

Some participants reported feeling isolated in their programs and lacking belongingness in their cohorts. Teresa said this about her department: "*The rest were [other racial and ethnic groups] people. I felt like I was nowhere. I felt like I didn't belong anywhere.*" Teresa was the only Latina woman¹ in her cohort pursuing a graduate degree and felt as if she didn't belong with her peers. She was among other participants that had unique intersectional identities in their course cohort. Hope talked about often being the only Muslim woman in many of her courses. Here she expresses what a typical classroom experience was like for her:

Initially in a classroom, I don't always feel welcomed to go into an American group. Also, not in a [other country] group, because they are always speaking [another language]. Rather I'll choose to go in an [ethnic] group or some other similar ethnic group. (Hope, Interview 1)

Due to being a visibly Muslim Women of Color, Hope didn't fit in with the American groups because she experienced a "*hidden barrier*" that made her feel unwelcomed. She also couldn't join other international groups who were neither speaking English nor a language she understood, leading her to find peers from a similar ethnic background as her cohort. Fortunately, by the time of Interview 2, Hope told us "*I'm not feeling that much isolated [anymore] because I have my lab mates, classmates, and other students from my [home country].*" Rodrigo who had mostly White American peers in his courses, reported feeling isolated in his department:

For my research, I'm happy to be around, and the opportunities I have. Community-wise, things are getting better since I moved here, but I feel a little dislocated or isolated. Of course, I made some good friends. But [my] cultural background prevents me from feeling fully embraced or welcomed by the department. (Rodrigo, Interview 1)

¹ The identities of participants will be called out when relevant to the quote.

Rodrigo acknowledged that being in the US gave him many opportunities not available back home, but that department wise, it was isolating due to having a different cultural background. Students overall were satisfied with the research opportunities they are presented with in the US compared to their opportunities back home. However, the research environment wasn't always diverse, and therefore some students don't fit into the demographics of the department which results in feelings of isolation. Rodrigo ended up making friends that are also from Latin America whom he could be himself around while feeling fully embraced. As we will see next, students tended to find such safe spaces with other students from similar cultural backgrounds where they felt welcomed by just being themselves.

There were also feelings of isolation within the whole department that students mentioned. Raj explains how he feels isolated within his department: *Feeling isolated in the department is a thing. I don't know if it's a university issue or a faculty issue, but faculty don't interact with other faculty... People should know what other people are doing, why they are doing, all those aspects. So that kind of isolation could be better if there were more channels of communications. Secondly, I feel there is also isolation between faculty and students. So, I think if you take a course then you get to know faculty, but what about where they came from?* (Raj, Interview 2)

Raj mentioned how isolation may be common in his department, and that it could reflect larger departmental issues such as a lack of faculty collaboration or a lack of personability on the part of professors. He offered two departmental suggestions to decrease the isolation of students in the program. The first is the importance of having more collaboration between faculty and second is the need for more personal connections between professors and students.

Safe Zones & Social Segregation

As a result of feeling isolated and being in a foreign country, international students at PWIs in this study tended to look for safe spaces both in academic and non-academic circles. Academically speaking, students may look for an advisor and work with other students of a similar cultural background; however, this depends on whether they are adequately represented in their departments. For example, people from India and China make up a significant portion of graduate students in computer science programs, making it more probable for them to find advisors and peers from their own cultural background. Jay, who has been an international student in the US since 2017, said:

I think people [from a specific ethnicity] want to have more people [from their ethnicity] in their research group and people from different countries want to have some people from the same country in their research group. Like in my research group, there are eight people and six of them are from [countries like mine]. But in another group, the professor is from [another country] and there's about 15 people in his group and most of them are also from [that country]. (Jay, Interview 1)

Jay's experiences corroborated many of our other participants' experiences

of being in a lab with people from similar cultural backgrounds. Raj, Michael, Faiz, and Nick also mentioned being in labs whose demographics or advisor reflected their own cultural identities. People may feel more comfortable working with people who share similar cultural backgrounds or identities (language, customs, culture, religion, etc.). Having an advisor from a similar background may allow students to better communicate their ideas with their advisors and vice versa, thus enhancing mutual understanding and productivity.

The fact that computer science has a high representation of people from particular countries resulted in many of our participants having peers from the same cultural background in their cohort. Rachel mentions:

My department was basically filled with [people from particular countries], I would say, rather than Americans and other people. I rarely saw people from other countries in the class, I always tend to just hang out with the people from my country (Rachel, Interview 2)

Besides Rachel, other participants in computer science such as Ananya, Blue, Kojima and Nick, reported that their cohorts consisted of many Indian and Chinese students and less American students. Rachel made a lot of friends with peers in her cohort due to being part of the majority, resulting in little to no social barriers for her. For students who don't fit the demographics of the majority, they may have a harder time socializing with peers. In Interview 2, Faith mentioned "if we had a class of 20 people, I would say that 10 or 12 would be Indians, five Chinese, and two Americans. And then there is me."

Moving beyond the academic setting, students reported having personal social circles with people of their own cultural background. Jay discusses this:

I have two social circles, one for academia and another for personal. In academia, it's very diverse. But my personal social circle is mostly [from my country]. (Jay, Interview 1)

Jay was the only participant that explicitly spoke about having two social circles, but this concept was shared among many other participants. Kojima said:

I have some [ethnically] close friends here too, and they've been here for like 10 years or 30 years, there's a lot of difference. Sometimes they take me out to dinner, to amusement parks, or go hiking. (Kojima, Interview 1)

Kojima found his closest friends outside of the university and they were also from his country but had been in the US for much longer than him. The range of age of his friends may reflect the low population of people near Kojima that are from his country, along with an urgency to find other people from a similar background. As another example, Darlene acknowledges:

We kind of make bonds with people of the same color. So, that is the reason I have all my friends [from my ethnicity], over here till now. So, the interactions with people have all been good till now. (Darlene, Interview 1)

Darlene's remarks resonate with one of Jay's remarks earlier and confirms that people often look to their own cultural groups for guidance and protection. Darlene also acknowledges that she hadn't had any negative experiences so far because she has all friends with a similar background. Our participants tended to make two social circles, academic and social, with many preferring the personal social circle to include peers from

the same or similar backgrounds.

These safe spaces are so important that students often sought out others from their university through social media so that they would have a community of their own cultural background. Ananya mentions:

So, people coming from [country], they do have these WhatsApp groups for universities, or they have this website called Yocket where you can meet people beforehand or at least talk to them if you're in the same domain. So yeah, that's how we connected in the beginning, we just had a few messages, and then we connected during the lectures. That's how I also met my roommates. (Ananya, Interview 2)

Ananya took initiative before coming to the US and joined a social media group to meet other people from her country that were going to her university. This meant that most of her personal social circle during her time in the US consisted of people from her own cultural background. Other students sought out safe spaces through university organizations. Raj explains his experience:

The [ethnicity] community is strong here, there are very good people that help. They have a group, an [ethnicity] student association. When you come here, they come to pick you up, they give you somewhere to stay for a few weeks. For like 7-8 days initially when you are settled out. These are just like students, like me and others. (Raj, Interview 1)

These organizations offer international students of color a safe space, both emotionally and literally, by aiding new arrivals as they adjust to life in the US. These organizations often welcome new students, guide them through the transitional process of being in the US, and act as a support group throughout the graduate school process. These associations are greatly beneficial to students and provide new international students with resources and contacts.

While safe spaces were sometimes sought out by international students, at other times these safe spaces were created due to feeling isolated and experiencing unwanted segregation from their peers. Faiz explains:

To be honest, unfortunately enough, most of my good friends are [my ethnicity]. To me, that's unfortunate. It's not that I want it to be that way. It's not that I prefer it to be that way, or it's not that I designed it to be that way. I tried to make friends with my co-peers (Faiz, Interview 1)

Faiz would have liked to have made close friends with Americans, but things did not go smoothly, which led to him making mostly good friends from his own country. During his interview, he also stressed how difficult his first year was because he was unsuccessful in making friends with his American peers and that things got better after making friends from a similar background. Rodrigo also had similar experiences:

I have better friends in the Center for Latin American Studies, because they have people from many countries, that can speak in other languages. I don't think I'm selecting the people, it's just it's innate when you're comfortable with certain people that you realize they're respecting you, that don't make fun of you, but instead share interests or understand your background. (Rodrigo, Interview 1)

Rodrigo tried to become friends with American peers in his cohort which

resulted in experiencing a lot of discrimination. He described the environment as "toxic" and ended up making Latin American friends who are much closer to his cultural background.

Cross-Cultural Interactions

While academic settings are diverse and present many opportunities for students to interact with people from other cultures, few participants formed close relationships with people outside their cultural background. The few students that did form close friends with people from other cultures did so in class, in their research labs, and in other organizations at the university. However, there were also instances of conflict that occurred during cross culture interactions which some of our participants recalled.

Forming Social Circles in Diverse Academic Spaces

The only instance of a participant making relationships with other diverse peers in their cohort was Alice. Alice was in a unique program where there was no clear majority in her cohort, resulting in a very diverse environment:

There aren't too many [her ethnicity] in my class. So, one of my friends is [another ethnicity]. I have a lot of American friends. I have a couple of [her ethnicity] friends, and I have a [another ethnicity] friend... We went hiking and discovered that we are slight nerds, so we decided to start this Dungeons and Dragons group, so we meet every Friday and it's a very diverse group (Alice, Interview 2)

Due to the lack of majority, Alice made friends with peers of different cultural backgrounds. We asked Alice how she accomplished having diverse friends and she mentioned trying to find similarities with people and building conversations around that. After having found common interests, her friends would gather to do them together, forming relationships in the process.

While many students didn't make diverse friends from class, some managed to establish good relations with their diverse peers in their research labs. Peter reported being friends with his diverse research group:

There are people of different ethnicities, and there's only one white guy, the PI is American. So, my social circle will be those [ethnicity 1] guys, and the [ethnicity 2] and the token white dude. (Peter, Interview 1)

Although his lab consisted mostly of people from one continent, there was a good mix of countries and a white graduate student served as Peter's research advisor. Peter said how they often went out to eat or watch movies, and how his white American peer and research advisor was very culturally sensitive. Hope was also able to form a close bond with her lab peers:

My lab is just like a family. For example, just two days before my submission date, I was so scared about the editing and doing the proofread and everything. All my lab mates were voluntarily offering me, "Okay, I'm reading your Introduction. I'm reading

your Methodology, and I am fixing the grammatical mistakes, so you don't have to worry. (Hope, Interview 2)

Hope was able to find friends in her research group, which she found to be very supportive of her and her research. In this example, Hope's lab mates provided her support with writing, but she also expressed how they are helpful for other things like helping with presentations or research activities.

Two other students were able to establish diverse social circles outside of their cohort and department. Michael reported having a diverse mix of friends:

Until now, I have made friends with a few Latin American friends and a few from Europe who also felt left out so we just got together, and we made friends so that's how it mostly worked out. (Michael, Interview 1)

Michael was our only participant that served in a leadership position at their university, thus giving him more opportunities to meet and make friends with people from other cultural backgrounds. After following up with him about this issue in Interview 2, he mentioned how *"being an extrovert and social person help."* with finding new people to talk to at events he'd go to. Rachel was also able to overcome cultural barriers by making friends through other university organizations:

Yeah, it was because of some of these clubs, because when I went there, it was not only like they had interest in painting, but also had interest in hiking as well, so that's how we all got introduced to ourselves. (Rachel, Interview 2)

Rachel first formed her social circle with peers from similar backgrounds in her cohort, but after some time, she sought out other people with similar interests as her by joining different university organizations. She also admitted that having lots of friends from her ethnic background at first gave her the social support she needed to gain confidence to engage with other communities of people.

Potential for Cross-Cultural Conflict

When putting people from different cultures together, there are various factors that may dictate how the interactions take place. One factor is the demographics of a cohort, particularly whether there is a clear majority group or not. Alice explains:

So, I personally feel that, having too many people from the same place, you kind of form a gang with them and then you bully the others. I was talking to some of my seniors whose cohort had a lot of [ethnicity]. When I told them that, "these people are making comments like this to me," they were like, "Oh, you know what, in my cohort, we made the comments." So, I wouldn't blame any nationality or culture, or anything. It's just the human mentality; you kind of group with people and kind of pick on the minorities. (Alice Interview 2)

Having too many people from one place increases the possibility of the majority grouping together. Alice had experienced some discrimination for being from her ethnic background in class since she was part of the minority. When recounting her story to a senior student, the student mentioned being the majority in their cohort and making those comments instead of receiving them. This illustrates

how dominant groups can be discriminatory against minority groups in the classroom setting as well as in other settings.

Another factor that may play a role in cross-cultural interactions is the geopolitical relationships between two countries, which are often reflected in popular media as propaganda. A classic example is countries with border disputes and similar trade ambitions. The geopolitical relationships of the countries may impact the interactions between people from those countries. This is apparent in a story Darlene told us:

I think most of the badminton courts are actually taken up by [two ethnicities] people. There are six courts, three of which are taken by [one ethnicity] and three are taken by [another ethnicity]. We almost had a fight the other day because they took up four courts. They were not even leaving the court saying, "we arrived early so we will leave whenever we want to, we won't rotate." So even in sports, something like sports we were not able to do intra-cultural things, that was weird, it's very rare that we play in mixed teams... (Darlene, Interview 2)

From Darlene's experience, we learned that students from these distinct backgrounds rarely ever play together, even though they all love badminton. We asked Darlene how these relationships play out in the department, and she mentioned there being even less interactions between the two groups in the departmental setting. Darlene also acknowledged that the political and social influences between the two ethnicities likely factored into this negative dynamic.

SUMMARY AND DISCUSSION

Summary and Connections to Other Work

The results in this paper highlight the cultural and social barriers that international students may face in STEM graduate programs in the US. Some of the cultural and social barriers that limited the social interactions our participants could have included language, American popular culture, and general social norms. These barriers greatly impacted the experiences of our participants and likely resulted in most of the participants forming communities with people from the same, or similar, ethnic backgrounds. However, finding communities was challenging for students who came from less represented countries, and these students were more likely to experience isolation. A few participants were able to make cross-cultural connections, but they were due in part to their specific academic environment and their self-reported extroverted personalities. The impact was also seen in the results which are recapped below.

The first theme of the results, *Cultural Barriers*, led to a discussion of some of the hurdles international students must deal with due to being in a new country. The first major challenge our participants reported having concerned their communication with others using spoken or written English. There are studies in English-speaking countries, including the US, that show that international students

often have a low proficiency in English when starting their programs (Kuo, 2011; Yanyin & Yinan, 2009). English exams such as the TOEFL or the IELTS require more vocabulary than proficiency and focus on proper English, which is not always helpful in social situations where cultural and/or contextual words are used. Fortunately, there is some evidence that the language barrier is greatly reduced after two years of being in an English-speaking country (Benzie, 2010). However, as seen in our results, the COVID pandemic may have prolonged this two-year adaptation window, since social distancing greatly limited the social interactions needed to improve English proficiency.

Even international students with a high English proficiency faced difficulties when teaching because of their accents. This often resulted in complaints from students in their classroom and lower teaching evaluations. Other studies have also found that international scholars may also face discrimination due to having an accent (Wei et al., 2012) and other challenges associated with having a non-American accent (Ramjattan, 2022), hinting that there may be less tolerance for foreign accents at PWIs. Beyond fluency and accents, our participants reported not being familiar with popular culture or other social norms that are different from what they know. Our participants found it difficult to jump into conversations and engage their American peers since they often missed cultural references that they were unfamiliar with. These, along with other adjustment factors, represent the challenges that many international students face (Andrade, 2006; Smith & Khawaja, 2011). Some of our participants found that social norms caused cultural barriers, such as different body language or eating with your hands as opposed to a fork. Again, the differences in cultural norms experienced by our participants are also corroborated with other studies of international students (Medved et al., 2013).

The cultural and language barriers students felt may have been significant factors that led to isolation and segregation. Some of our participants were the only people of their own cultural background in their cohorts which led to them feeling isolated in their program and led them to seek socially-safe spaces. Our participants from more highly-represented countries were often segregated, mostly socializing with culturally similar people. Due to the challenges of interacting with white American peers (Williams & Johnson, 2011), most of our participants reported not making friends with American peers. Many of our participants reported having diverse academic spaces but non-diverse social spaces, which reflects the lack of cultural cohesiveness but also resulted in the provision of safe spaces for students. These social supports are especially critical in the first few months of transitioning to living in the US (Hechanova-Alampay et al., 2002).

Many of our participants from more represented ethnic groups ended up making friends with people of similar ethnicity, while those from less represented ethnic groups tended to make friends outside of their culture. This is in line with other work where Indian and Chinese students often segregated into their own groups, while those from less represented countries tended to be "global mixers," meaning that they were able to form diverse social circles (Rose-Redwood & Rose-Redwood, 2013). When cross-cultural interactions did take place, they were mostly positive and often came through being part

of a diverse research lab or participating in diverse student organizations. These strategies as well as attending cultural events and performing community service all have been known to encourage cross-cultural interactions among students (Glass & Westmont, 2014). However, caution is warranted as Darlene reported an instance of conflict between her ethnic group and another ethnic group. Historical and political divisions between certain groups should be given consideration regarding mixing different ethnic groups in certain settings.

There are theoretical foundations that support the challenges international students face which begin with being migrants to a new culture. Acculturation theory may explain the lack of cross-cultural interactions between our participants and their American peers (Smith & Khawaja, 2011). The process of acculturation includes many adjustments that international students make while living in the US. Finding peers from similar cultural backgrounds helps with the acculturation process by allowing people to speak in their native language and discuss culturally relevant topics. Aside from the preferred familiarity of being connected with others from the same cultural group, many students simply find it challenging to become friends with Americans. Some international students have reported challenges in socializing with their domestic counterparts due to American peers positioning themselves as superior, asking stereotypical questions, and not taking them seriously (Will, 2019). International students who are able to socialize with their American peers tend to become more comfortable with American culture (Trice, 2004). In all, this acculturation process may have a negative impact on international students' mental and emotional wellbeing, due to cultural barriers (Girmay & Singh, 2019; Sümer et al., 2008). These issues are of much greater concern for international students than for domestic students who may already have well-established networks within the US (Hechanova-Alampay et al., 2002).

Implications and Possible Solutions

International students are subject to cultural and social challenges as they adapt to US society. There are ways for universities and departments to alleviate some of these challenges. To help international students facing English barriers, universities could provide writing labs, free English courses, and teaching assistant training for these students. To succeed, international students also need academic support such as mentors, advisors, and colleagues, as well as non-academic support structures, such as friends and other helpful people. To help students find the right academic support, departments can encourage collaboration between labs, as suggested by one of our participants, and provide support for students to explore multiple labs before deciding on which one to commit to. Most of our participants mentioned their social groups consisted of their own ethnic group. This may change if universities and departments were to host events that create opportunities for students to cross cultural and social barriers allowing for further integration. However, as seen in this article, when encouraging cross-cultural interactions, there should be some consideration given to

making sure that different groups are able to interact in a safe and positive manner.

This research, as well as the research cited, stresses the importance of providing support and promoting cultural awareness to improve the inclusion of international students at American universities. The use of more inclusive pedagogies in graduate school would allow students to work frequently in small groups and encourage cross-cultural interactions among international and domestic peers. Hurtado argues that PWIs may adopt solutions such as enhancing funding to diverse student organizations, recruiting more students of color, implementing programs to help all members of the campus identify and confront prejudices, being purposeful in articulating the value of cross-cultural interactions, and adopting initiatives for universities to increase their services to international students (Hurtado et al., 1998). Another potential solution may be the use of technology to remove some of the physical barriers students may face. We saw this in our own research when Hope's white American peers rushed to help during the pandemic which dictated an online learning platform. The technology appeared to have allowed students to respond quickly and efficiently to Hope's needs, perhaps even showing Hope that some of the barriers she perceived may not have existed. On a broader level, institutions could host community events that place an emphasis on the importance of promoting cross-cultural dialogue so that international students have an alternative to total assimilation into US culture (Rose-Redwood & Rose-Redwood, 2013). Cross-cultural university experiences help reduce cultural barriers, which benefits all students by encouraging the formation of more diverse communities of friends, which will lead to a more tolerant society.

LIMITATIONS AND FUTURE DIRECTIONS

The limitations of this study include the demographics of our sample and the fact that three of the four authors lack experience being an international student. In our sample, we had a large representation of students from southern Asia, which may have added some bias towards experiences that may be unique to this demographic. Most of our participants were computer science majors, which again may have added bias. Three of the authors were born in the US which may have impacted the study, although the third author was born in Egypt and played a major role in the analysis and review of this article.

Future directions of this work could include conducting follow-up interviews with our participants to ask them further questions about their intersectional experiences. To this end, we have devised a research protocol to allow us to expand on the uniqueness of the participants' individual experiences. We plan to ask more questions regarding the racialized experiences of our participants, including how the university might have impacted those experiences. Finally, we are interested in learning about how the participants' social networks, peers, and mentors played a role in both their adjustment to the US and their overall success in STEM graduate programs.

DECLARATIONS

Availability of Data and Materials

The datasets generated and analyzed during the current study are not publicly available due to the sensitive nature of this research article and the implications of identifying participants. Further, for this same reason, the approval of this research, from the International Review Board, was also dependent on the anonymity of our data collection.

Compelling Interest

The authors declare that they have no competing interests in this section.

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Authors' Contribution

MR was in charge of all the aspects of producing this work, including but not limited to: recruiting participants, conducting interviews, the qualitative analysis, and the writing of this article. BZ helped conduct interviews and analyze the second round of interviews. MM contributed to the analysis of the participants by providing her valuable perspective as the only author who has been an international student in the US. RB assisted at every facet, whenever needed, this project was his idea and possible due to his grant. We all contributed greatly to the discussions around this article.

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APPENDIX

Interview Protocol (55-90 min)

Build more Rapport (10 min)

1. Introductions
2. Catch up with them
 - + How have you been?
3. Remind them a bit of the purpose of the study in a general way.

***** Can I start recording? *****

Main Protocol Questions

Baseline Questions (5 min)

1. What are your current career plans?
 - + Why do you want to go into _____?
 - + How are things going at work? (for people at work)
 - + How are classes going? (for those in classes)
 - + How is graduate school going?

Mentorship and Social Relationships (10-20 min)

2. Who has helped you throughout your graduate education and how?
 - + peers
 - 2a. (Anti-deficit) How did you get connected to them?
 - 2b. (Systemic Negative) What (was there anything that) made it hard to get connected to them?
 - 2c. (Systemic Positive) In what (were there any) ways did the department support/hinder those connections?
3. Who do you consider to be your mentors and why?
 - + How have they impacted your XP in graduate school?
- 3.5. (w/ previous grad XP) How do these mentorship experiences contrast to past experiences?

***** Look at time (give break minutes) *****

Intersectional experiences (prompt before asking) (10-15 min)

Prompt: Intersectionality is also important to us. It's not just about studying

People of Color, but also taking into account other possible inequities that may exist due to identities along with race including [tailored list]. In the first interviews we saw there were some of those differences and we think it's important to talk about these differences to promote more well-rounded supports for students of color.

4. With that in mind, how do you think your experiences as a student have been unique from other people of color due to some of the identities?

(for people that don't know) due to identities such as:

Gender

Sexual orientation

Disabilities

Language

Nationality /

Religion

Parenthood

Economic class

*****+ (If they have a short response) Last time you mentioned X, can you tell us more about how that affected your experiences?**

4a. (Anti-deficit)

IF Negative XP: Considering those differences, what did/do you do to overcome the challenges?

IF Positive XP: How do you think those differences help you maintain your progress through graduate school?

4b. (Systemic Positive) How do you think the department/school facilitate/help you through having those differences?

4c. (Systemic Negative)

IF Negative XP: (were there anyways you think that) How do you think the department/school make those differences worse?

What do you think the department/school can do to better support those differences (or challenges)?

Themes from Interview 1 experiences (10-20 min)

Prompt: In the first interview we asked "how have your experiences been different because you are a person of color?"

(2nd year students) are there any updates you'd like to share with respect to this question?

(continue with) We found themes common among participants and want to ask about the supports and barriers to some of the themes we found from Interview 1.

6. We identified the following five themes, which of these can you relate to and share some experiences you've had?

1. Barriers to interacting with people from other cultural backgrounds
2. Feeling isolated in the department or during graduate school
3. Forming social circles with people from similar backgrounds.
4. Experiencing discrimination in the University or outside of campus
5. Experiencing features of whiteness (ex. privilege, fragility, saviorism, etc.)
- 6a. (Anti-deficit) Considering those experiences, what did/do you do to overcome those challenges?
- 6b. (Systemic Negative) How do you think the department/school made those experiences worse?
- 6c. (Systemic Positive) How do you think the department/school helped you through that experience?
- 6d. (Systemic Negative) What do you think the department/school can do to better support people through those experiences?

Closing Questions (5-10 min)

1. What are your favorite memories of your graduate school experience so far?
2. What do you think you will remember the most in 10 years?
3. Anything else you want to say before ending the recording?

***** End recording *****

Post interview (5-10 min)

1. Is it okay to edit your interview transcripts for clarity and brevity?
2. With which races or ethnic GROUPS do you identify with?
3. How do you describe your gender and what pronouns should we use for you?
4. Which of the following are relevant to you and how do you identify:

Sexual Orientation

- a. *Disabilities*
- b. *Nationality*
- c. *Religion*
- d. *Do you have children or a family?*
- e. *Economic class*
5. Tell them the longitudinal plan and ask them if they would be willing to be contacted again in 9-10 years?
6. Collect an email they'll still use in 9-10 years
freedom of industry
7. Thank one last time and wrap up interview