




Speaking up for the invisible minority: First-generation students in higher education

Vijayvardhan Kamalumpundi¹ | Sophielle Silvers² | Latisha Franklin^{2,3} |
Kit Neikirk⁴ | Elsie Spencer^{4,5} | Heather K. Beasley⁴ | Celestine N. Wanajalla⁶ |
Zer Vue⁴ | Amber Crabtree⁴ | Annet Kirabo⁶ | Jennifer A. Gaddy^{7,8} |
Steven M. Damo^{9,10} | Melanie R. McReynolds² | Latanya Hammonds Odie¹¹ |
Sandra A. Murray¹² | Maria Elena Zavala¹³ | Arnaldo Diaz Vazquez¹⁴  |
Antentor Hinton Jr.⁴  

¹Department of Internal Medicine, Roy J. and Lucille A. Carver College of Medicine, Iowa City, Iowa, USA

²Department of Biochemistry and Molecular Biology, Eberly College of Science, Pennsylvania State University, University Park, Pennsylvania, USA

³Millenium Scholars Program, Eberly College of Science, Pennsylvania State University, University Park, Pennsylvania, USA

⁴Department of Molecular Physiology and Biophysics, Vanderbilt University, Nashville, Tennessee, USA

⁵Teachers College, Columbia University, New York, New York, USA

⁶Vanderbilt Department of Medicine, Nashville, Tennessee, USA

⁷Department of Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA

⁸Department of Veterans Affairs, Tennessee Valley Healthcare Systems, Nashville, Tennessee, USA

⁹Department of Life and Physical Sciences, Fisk University, Nashville, Tennessee, USA

¹⁰Center for Structural Biology, Vanderbilt University, Nashville, Tennessee, USA

¹¹Department of Biological Sciences, Georgia Gwinnett College, Lawrenceville, Georgia, USA

¹²Department of Cell Biology, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

¹³Department of Biology, California State University, Northridge, California, USA

¹⁴Graduate School of Biomedical Sciences, University of Texas Southwestern Medical Center, Dallas, Texas, USA

Correspondence

Arnaldo Diaz Vazquez, Graduate School of Biomedical Sciences, University of Texas Southwestern Medical Center, Dallas, TX 75390, USA.

Email: Arnaldo.DiazVazquez@UTSouthwestern.edu

Antentor Hinton Jr, Department of Molecular Physiology and Biophysics, Vanderbilt University, Nashville, TN 37232, USA.

Email: antentor.o.hinton.jr@vanderbilt.edu

Funding information

NSF, Grant/Award Numbers: MCB#20115771, EES2112556, EES1817282, MCB1955975; NIH, Grant/Award Numbers: T325T32GM133353, T32GM137863, GMT34GM136450, R25GM116707; Chan Zuckerberg Initiative DAF,

Abstract

A first-generation college student is typically defined as a student whose biological parent(s) or guardian(s) never attended college or who started but did not finish college. However, “first-generation” can represent diverse family education situations. The first-generation student community is a multifaceted, and intersectional group of individuals who frequently lack educational/financial resources to succeed and, consequently, require supportive environments with rigorous mentorship. However, first-generation students often do not make their identity as first-generation students known to others due to several psychosocial and academic factors. Therefore, they are often “invisible minorities” in higher education. In this paper, we describe the diverse family situations of first-generation students, further define “first-generation,” and suggest five actions that first-generation trainees at

an advised fund of Silicon Valley Community Foundation Science Diversity Leadership, Grant/Award Numbers: 2022-253614, 2022-253529; National Institutes of Health PRIDE Program, Grant/Award Number: DK020593; The United Negro College Fund/Bristol-Myers Squibb E.E. Just, Grant/Award Number: FacultyFund; Vanderbilt Diabetes and Research Training Center for DRTC Alzheimer's Disease Pilot & Feasibility Program, Grant/Award Number: DK020593; Burroughs Wellcome Fund, Grant/Award Number: 1021868.01;Ad-Hoc

the undergraduate/graduate stages can engage in to succeed in an academic climate. We also provide suggestions for mentors to accommodate first-generation students' unique experiences and equip them with tools to deliver intentional mentoring practices. We hope that this paper will help promote first-generation student success throughout the academic pipeline.

KEYWORDS

DEI, first-generation students, invisible minorities, mentor

1 | INTRODUCTION

Currently, one-third of all U.S. college students identify as first-generation at higher learning institutions (see <https://firstgen.naspa.org/about-the-center/about-the-center>, accessed August 15, 2023). The first-generation student community is a growing, diverse, and complex population. Though not always, first-generation students often hide their identities as a first-generation students to their peers due to several psychosocial and academic factors. As such, they are often "invisible minorities" in higher education (Canning et al., 2020; Soria et al., 2022).

Simply defined, a first-generation college student (FGCS) is a student whose biological parent(s) or guardian(s) never attended or did not complete a 4-year university or college program. However, FGCS can represent diverse and complex family education situations. A few examples of this are: parent(s)/guardian(s) who enrolled in college but never graduated, one parent who graduated and the other never having attended college regardless of the education level of the other adults in their lives among many other definitions. Importantly, "first" may refer to the first college student in the nuclear family and may include biological family or guardian/adoptive family. Additionally, the definition of FGCS does not exclude higher levels of education. For example, a student may identify as FGCS for graduate school or professional programs if this level of education was not previously reached by any member of their family. Currently, only 10% of first-generation students go on to graduate school (Fry, 2021; Redford & Mulvaney, 2017).

Though it has not been empirically studied, we believe FGCS greatly enrich the education space by offering a unique insight into their classes that are informed by lived experiences. Most FGCS, however, do not have a mentor to guide them as they seek to achieve their aspirations (Bettinger & Baker, 2011). High-quality mentors are necessary to retain this valuable demographic in higher education, and in guiding FGCS to personal and professional success (Bettinger & Baker, 2011). Currently, there is little published data to support best practices in mentoring FGCS. Indeed, current research and rhetoric on mentoring FGCS in higher education focuses on a deficit-based approach (LeBouef & Dworkin, 2021). That is, focusing only on the deficits of FGCS such as limited social support and low socioeconomic status background for example, as compared to continuing education students (LeBouef & Dworkin, 2021) However,

this approach discounts the strong family connections, and resilience that FGCS often possess (Canning et al., 2020). Mentors and educators must aim to empower their first-generation mentees by identifying and leveraging individual strengths to increase the likelihood of success and promote self-efficacy in an asset-based approach.

In this paper, we suggest five actions that FGCS at the undergraduate and graduate levels might use to successfully navigate their academic climb. We provide seven suggestions to mentors on to enhance their success in mentoring FGCS' and support a welcoming learning environment for all students. We also aim to equip mentors with tools to deliver intentional mentoring practices to ensure FGCS success throughout the academic pipeline. We start with a discussion of the challenges of being a first-generation trainee and then present suggestions for the trainee/mentee and mentor.

2 | THE DIFFERENTIAL CHALLENGES OF FIRST-GENERATION TRAINEES

Only 11% of low-income, FGCS have a college degree within 6 years of enrolling in school (See <https://files.eric.ed.gov/fulltext/ED504448.pdf>). In contrast, student who are not low-income or FGCS graduate at 55% after 6 years. This dismal graduation rate for FGCS stems from multiple issues that disproportionately impact them. We have categorized these issues here as psychosocial, financial, and academic challenges.

2.1 | Psychosocial challenges

2.1.1 | Imposter syndrome

Imposter syndrome is where successful individuals feel that their achievements were accomplished by circumstance (e.g., timing, charm, luck), rather than the student's ability or qualifications (Clance & Imes, 1978). These feelings can easily be cause or exacerbated by effects including macro and microaggressions (Marshall et al., 2021). FGCS are especially vulnerable to experiencing imposter syndrome as they may not have a social network informed of the college experience to rely on when

challenges arise. This can lead them to doubt their own abilities. In addition, feelings of competition among students enrolled in college courses, notoriously in STEM fields, may arise in academics that affect FGCS to a greater degree (Canning et al., 2020). FGCS in STEM fields are an important demographic to be mindful of given how STEM courses are generally taught at the university level. Contrary to, though not always, to the arts and other academic fields, STEM courses often pit students against each other in a zero-sum manner (Canning et al., 2020). This can be through the use of a curve to grade student performance, or through the use of harmful rhetoric that implies that competition is the only way to succeed in the course (e.g., “look to the left and look to the right, at the end of the semester only one of you is left” mentality) (Canning et al., 2020). A recent study by Canning et al. demonstrated that both the direct and indirect effects of perceived classroom competition on daily experiences of feeling like an imposter on course outcomes were 2–3 times greater among FGCS, compared to continuing education students (Canning et al., 2020).

2.1.2 | Social isolation

Isolation from social circles is a common phenomenon among FGCS. Additionally, lower expendable financial resources can limit the ability of FGCS to participate in social events on campus, adding to feelings of isolation and limiting their ability to network with their peers. Weak social support has been shown to be associated with worse mental health, including a six-fold increased risk of depressive symptoms relative to students with high-quality social support (Hefner & Eisenberg, 2009).

2.1.3 | Anxiety

In addition to the normal stressors of starting college such as academic challenges and homesickness in continuing education students, FGCS are forced to tackle additional causes of anxiety. A recent study by Noel et al. demonstrated that first-generation status was associated with increased cognitive-emotional, and somatic anxiety symptoms (Noel et al., 2023). Another study showed that 40.3% and 44.6% of 7269 FGCS surveyed across nine large research universities experienced clinically significant symptoms of major depressive disorder and generalized anxiety disorder respectively (Soria et al., 2022). One of the major factors that drive anxiety in FGCS is the feeling that they must “bring honor” and “pull their family out of poverty.” This may set even higher expectations for FGCS. These sentiments are akin to the “model minority myth” that affects Asian American students (Vue et al., 2023). Additionally, we feel FGCS bear an additional consideration of complex family situations such as feeling shame for not being able to be physically home to care for siblings, perform house chores, attend to family events, or contribute to family's finances.

2.1.4 | Stigma/Discrimination

Racial minorities and ethnic groups make up ~54% of the FGCS population (Schuyler et al., 2021). As such, many FGCS must overcome racial disparities and discrimination to succeed in academic settings. Current data suggests that FGCS report higher levels of classism on campus from peers, professors, and their institutions. Others report feeling embarrassed due to misinterpretations by course instructions or peers that are linked to their economic realities (Havlik et al., 2020; Rice et al., 2017). Additionally, a recent phenomenological study showed that the label of “first-generation” was associated with feelings of being an “outsider,” a feeling that was generally associated with comments invoked by their peers who were not first-generation identifying (Havlik et al., 2020). These negative experiences with higher education invoke feelings of isolation and invisibility, and can contribute to poor mental health.

2.2 | Financial challenges

2.2.1 | Taking care of the basics: Family and income

FGCS are forced to navigate unique financial circumstances that profoundly impact their experience in higher education and place them at higher risk of not completing their degree program (Fry, 2021). A recent study among 12,295 continuing education and FGCS demonstrated that FGCS were significantly more likely to use federal student loans, private student loans, money from a job, scholarships/grants, and credit cards to fund their education, whereas continuing-generation students were more likely to use parent and family income (Rehr et al., 2022). Additionally, FGCS exhibited lower financial literacy than continuing education students in the same study (Rehr et al., 2022). High university costs push FGCS to take on extra jobs to cover additional financial expenditures thus taking away precious time from studying their coursework. Data from the National Center for Education Statistics demonstrates that first-generation students are likely to attend more classes part-time, are older than the general student population, and have more children (see <https://nces.ed.gov/pubs2018/2018421.pdf>). Additionally, families of FGCS are more likely to be less financially sound. This is illustrated by stark differences in median family income of incoming first-generation students at 2–4-year institutions of \$37,565 compared to \$99,635 for incoming continuing-generation students (see <https://nces.ed.gov/pubs2015/2015167.pdf>). As income inequality continues to rise (Horowitz et al., 2020) disparities among first-generation students will likely continue to widen.

2.2.2 | Systemic financial barriers and navigating assistance programs

This pertinent need for financial and academic resources targeting FGCS was the basis behind the formation of Cumbersome enrollment

processes and a confusing array of paperwork associated with applying for public benefits can impede FGCS from accessing several important public assistance programs including financial aid. Both federal and state governments allocate billions of dollars annually in need-based financial aid to support low-income students, many of them FGCS, to access and succeed in college. Indeed, several lines of research suggest that need-based aid may substantially increase the number of students who enter and graduate from college (Scott-Clayton & Zafar, 2019). However, thousands of students who would qualify for financial aid otherwise do not complete the Free Application for Federal Student Aid (FAFSA) each year. Some studies suggest that students leave upward of \$3.6 billion USD in unclaimed grant assistance (AlQaisi, 2022). For FGCS, it is imperative that they complete FAFSA as they may be eligible for Pell grants, a grant that is awarded to undergraduate students who display financial need and have not completed a bachelor's, graduate, or professional degree. Nationwide, 34% of undergraduate students receive Pell Grants, while more than 45% of FGCS qualify for this type of funding (NASFAA, 2021). Based on these numbers, ensuring that potentially eligible students complete FAFSA would benefit many FGCS. However, some unique barriers to completing FAFSA include: lack of awareness and information about financial aid, misconceptions about potential eligibility, and/or reluctance to complete FAFSA due to the complexity. FGCS are more likely to have unique parental living situations and have difficulty obtaining verification of income. High school counselors play a key role in disseminating information about FAFSA, however, they may not have the training or knowledge about community resources to fill out FAFSA. In fact, many access institutions, communities, and state agencies offer free assistance for completing the application. A good next step may be to educate high schools, and university/college faculty about local resources available for students to fill out FAFSA correctly.

In addition to offering federal financial aid, the federal government also formed TRIO. This to help assist FGCS financially and professionally (Thomas et al., 1998). TRIO is a federally funded series of eight programs targeting students from low-income backgrounds,

FGCS, and individuals with disabilities to help them progress through the academic pipeline from middle school to postbaccalaureate programs (Thomas et al., 1998). Available services include assistance with academic preparedness, navigating financial aid, personal counseling, tutoring assistance, career planning, among many others (Thomas et al., 1998). Universities, public and private agencies, and community organizations may apply for TRIO grants. Over 1 billion USD annually goes to TRIO programs, and the number of TRIO participants has grown by a staggering 261% since its inception in 1965 (Cahalan et al., 2022). Success of TRIO programs have been documented, including a recent national evaluation showing participants entering 4-year institutions were 23% more likely to obtain a bachelor's degree within 6 years than a nonparticipants' matched comparison group (Chaney, 2010). However, student criteria for entering a TRIO program is often stringent and based on federal guidelines such as having a full-time college enrollment and being a US citizen/eligible to receive federal aid to be eligible. Additionally, However, TRIO programs have been shown to serve a small portion of the individuals eligible for the programs (Cahalan et al., 2022) suggesting that students potentially even faculty are unaware of such services offered at their institutions. This highlights the need for similarly targeted programs at the local level and under the control of communities and university programs who may be better suited to reach students not meeting the criteria for the TRIO program.

2.3 | Academic challenges

2.3.1 | College readiness and difficulty navigating the academic system

College readiness is defined as the academic and practical knowledge required to be successful in higher education FGCS from lower-income backgrounds often attend high schools that lack rigorous college-preparatory tracks (Royster et al., 2015). Among parents of FGCS, there is a lack of familiarity with the significance of how the high school

TABLE 1 Actions for success of first-generation trainees.

Action	Benefit
1. Create a strong financial plan to support self	<ul style="list-style-type: none">• Provides the ability to be proactive about planning ahead after college, readying emergency preparedness funds and reduces overall financial stress
2. Create study habits tailored to your learning style	<ul style="list-style-type: none">• This can increase free time while ensuring learning is performed successfully thereby reducing academic stress
3. Build a supportive mentoring network, especially during uncertain or stressful times (Termini et al., 2021)	<ul style="list-style-type: none">• This can provide a sense of belonging and community for first-generation college student (FGCS) that can contribute to personal and professional development (Shuler et al., 2021)
4. Establish clear communication channels with trusted mentors and institutional reporting systems/supervising boards	<ul style="list-style-type: none">• This can also allow for student mistreatment from peers, faculty/staff to be reported in a safe manner (Marshall et al., 2021)
5. Have a healthy work-life balance (e.g. develop time management skills and be willing to say "no" to unreasonable requests from supervisors and peers (Hinton, McReynolds, et al., 2020)	<ul style="list-style-type: none">• Reduces the likelihood of burnout and boosts productivity in the classroom

TABLE 2 Actions to create a supportive environment for mentors of first-generation trainees.

Action	Data/Solution	Why do this?
1. Check in on mentee's basic survival needs (food, shelter among others)	<i>Data:</i> Food and housing insecurity is rampant across higher education institutions in the US (Olfert et al., 2021). <i>Solution(s):</i> Many institutions have community food pantries and basic needs centers (See https://basicneeds.uiowa.edu/ and https://basicneeds.berkeley.edu/home)	<ul style="list-style-type: none"> Familiarizing with campus food/shelter resources can help mentors sustain supportive learning conditions
2. Connect mentee with other first-generation faculty and students	<i>Data:</i> Networking in educational settings can promote academic success among students, and can encourage networking in careers which has been linked to career satisfaction and concurrent salary increase (Dokuka et al., 2020; Wolff & Moser, 2009). <i>Solution(s):</i> <ul style="list-style-type: none"> Help facilitate first-generation student meet-and-greet events Introduce students to first-generation faculty in mentor's network 	<ul style="list-style-type: none"> Helps ensure that first-generation students have multiple sources of support when navigating higher education Promotes a sense of belonging
3. Check in with mental health regularly and talk about feelings of shame and imposter syndrome	<i>Data:</i> First-generation status is associated with increased cognitive-emotional, and somatic anxiety symptoms (Noel et al., 2021). <i>Solution(s):</i> <ul style="list-style-type: none"> Having regular discussions about mental health through scheduled meetings. Having pamphlets with campus mental health resources on-hand if needed 	<ul style="list-style-type: none"> Helps students feel more comfortable talking about mental health Allows mentors to connect students with appropriate mental health resources earlier
4. Promote access to student services	<i>Data:</i> First-generation college student (FGCS) are more likely to use financial aid services but less likely to access academic support, advising, and health services (see https://blog.ed.gov/2021/04/supporting-first-generation-low-income-students-beyond-college-acceptance-letter/). <i>Solution(s):</i> <ul style="list-style-type: none"> Mentors should familiarize themselves with resources for first-generation communities including: peer support groups, TRIO services (if available), student-led organizations for FGCS, and similar programs Mentors should help facilitate access to these resources by gauging student barriers (e.g., time) 	<ul style="list-style-type: none"> Allows students to be better informed about financial options, academic support, and more
5. Discuss areas of strength and weaknesses and leverage these professionally	<i>Data:</i> Knowledge of strengths promotes academic achievement (Tang et al., 2019). <i>Solution(s):</i> <ul style="list-style-type: none"> Promote use of strength assessment tests and quotients to identify students' strengths (Neikirk et al., 2023) Have conversations about how to use student's strengths to achieve their professional goals Utilize existing and freely available workshops (Barongan et al., 2023; Marshall et al., 2022a, 2022b; Marshall, Brady, et al., 2022; Marshall, Palavicino-Maggio, et al., 2022) specifically developed for underrepresented students to help prepare them for graduate schools and encourage their holistic professional development 	<ul style="list-style-type: none"> Increases student self-efficacy to achieve by valuing their strengths Promotes professional development by encouraging students to capitalize on strengths
6. Advocate for first-generation students at the institution level	<i>Data:</i> Increased visibility of FGCS can help reduce stigma of the first-generation status label (Quinn et al., 2020). Robust infrastructure to support FGCS can greatly impact academic success, student retention, and well-being (Schuyler et al., 2021). <i>Solution(s):</i> <ul style="list-style-type: none"> Increase visibility of first-generation faculty on campus (PR campaigns) and FGCS who graduate Encourage representation of FGCS in campus leadership roles 	<ul style="list-style-type: none"> Developing infrastructure to support FGCS including: scholarship support, student services, and more can help FGCS achieve success
7. Improve positive environment and work-life balance of FGCS	<ul style="list-style-type: none"> <i>Data:</i> FGCS have differential family support mechanisms (LeBouef & Dworkin, 2021) that can lead to poor work-life balance 	<ul style="list-style-type: none"> Avoids early-career burnout and ensures FGCS can have sustainable habits that prevent resentment toward academia

(Continues)

TABLE 2 (Continued)

Action	Data/Solution	Why do this?
	<ul style="list-style-type: none"> • Solution: <ul style="list-style-type: none"> o Celebrate the achievements of your mentee as a form of positive reinforcement o Promote a work–life balance for mentees and encourage them to find hobbies o Offer skills to improve time management including structured to-do lists (Murray, Davis, et al., 2022) o Help mentees be realistic in taking on additional responsibilities and saying “no” to excess responsibilities (Hinton, McReynolds, et al., 2020) 	

curriculum relates to college readiness (Gamez-Vargas & Oliva, 2013). Furthermore, FGCS seldom knows how the college application system works, how to apply for financial aid, and more. Given that first-generation students are less likely than students from advantaged backgrounds to possess forms of cultural capital (education and academic skills among others) associated with high achievement, these students are less likely to participate in activities that lead to academic success such as group studying, using student services, and more (Schuyler et al., 2021). Taken together, these various factors can compound the stress on FGCS, leaving them lost, and allowing them to slip through the cracks or fall out of the pipeline (Hinton, Termini, et al., 2020).

2.3.2 | Message to mentees: Actions for success of first-generation trainees at the undergraduate and graduate stages

Though FGCS face many psychosocial, academic, and financial challenges, they can engage in the following tangible actions to increase the likelihood of success in higher education, some of which we have highlighted (Table 1).

2.3.3 | Message to the mentors: A few important actions on how to mentor first-generation trainees

This table offers a few simple actions that mentors can take to support FGCS at the undergraduate and graduate levels (Table 2). We identified areas of students' experiences that could negatively contribute to their academic experience and identified ways that mentors can augment a supportive learning environment. Of note, some of these strategies are informed by the authors' lived experiences in mentorship and as former first-generation students.

2.3.4 | Future considerations of challenges of first-generation students with intersectional identities

A unique population that merits further discussion are FGCS with intersectional identities. These identities could arise from unique family

situations (e.g., single parents), veteran status, personal health issues, immigrant status, gender identity, learners who speak English as a second language, and many others. An in-depth discussion about the multiple permutations of different identities and their interactions with being a FGCS is out of scope for this article, however, the complex, overlapping social identities highlight the need for mentors to understand the unique challenges each student faces on a case-by-case basis through cultural competency and humility (Murray, Hinton, et al., 2022). Additionally, as FGCS can include nontraditional adults or commuter students (Garrison & Gardner, 2012) greater research is needed to understand how intersectionality impacts this unique demographic of students as well. For example, while free meal pick-up may sound helpful for FGCS, if the time frame is offered at an inconvenient time, many commuter students may not be able to make use of this resource.

Beyond this, FGCS identifying as Black or Latinos and/or with disabilities (Crabtree et al., 2022) face unique challenges which may include the added barriers of systematic racism or inaccessible design. Recently, a major issue published in *Cell* has highlighted structural barriers impacting Black students (Mays et al., 2023) but how these may be exacerbated for FGCS is unclear. A good next step to characterizing the experiences and struggles of FGCS who are racial or ethnic minorities would be to conduct educational research at historically black colleges and universities (HBCUs) (Shuler et al., 2022) historically Hispanic serving institutions, tribal colleges and universities, and other minority serving institutions. In particular HBCUs and other minority serving institutions serve distinctive needs (O'Brien & Zudak, 1998; Shuler et al., 2022), and FGCS attending them may have unique experiences relative to primarily white institutions. In total, identifying structural barriers among these populations will be critical to understanding how mentors and institutions can help support FGCSs with certain intersectional identities. Steps to creating a more equitable academic experience for the invisible minority require intentional collaboration among all those involved. This ensures the resources created are accessible to FGCS.

3 | CONCLUSION

The first-generation student community is a multifaceted, intersectional, and often invisible group of individuals who enrich college communities with unique lived experiences. Numerous

socioeconomic barriers exist that impact success rates among FGCS. Supporting FGCS through informed and intentional mentoring as well as the removal of systemic barriers can greatly increase personal and professional success in FGCS. Institutions are uniquely positioned to dismantle systemic barriers for FGCS by mobilizing supportive campus resources, however, they require mentors who are aware of available campus resources for FGCS. As mentors of students who experience unique challenges, it is important to acknowledge these unique challenges on a case-by-case basis to inform how we mentor each student in higher education. Future work should be dedicated to characterizing the needs of students with intersectional identities to help identify areas where mentoring can also help these students. Furthermore, future work should be aimed at characterizing the unique needs of FGCS in different fields of academia such as in STEM fields. We hope this paper will serve as a starting point to inform and encourage the journey of FGCS in higher education and to inform mentors on how to model their mentoring practices to best suit FGCS.

AUTHOR CONTRIBUTIONS

Funding acquisition: Maria Elena Zavala, Arnaldo Diaz Vazquez, and Antentor Hinton Jr. **Supervision:** Antentor O. Hinton. **First draft:** Vijayvardhan Kamalumpundi, Vijayvardhan Kamalumpundi, Sophielle Silvers, Latisha Franklin, Kit Neikirk, Elsie Spencer, Heather K. Beasley, Celestine N. Wanajalla, Zer Vue, Amber Crabtree. **Editing and revising:** All authors.

ACKNOWLEDGMENTS

NSF grant MCB #20115771 and NIH T32 5T32GM133353 to Sandra A. Murray. NSF EES2112556, NSF EES1817282, NSF MCB1955975, and CZI Science Diversity Leadership grant number 2022-253614 from the Chan Zuckerberg Initiative DAF, an advised fund of Silicon Valley Community Foundation (to Steven M. Damo). The United Negro College Fund/Bristol-Myers Squibb E.E. Just Faculty Fund, BWF Career Awards at the Scientific Interface Award, BWF Ad-hoc Award, NIH Small Research Pilot Subaward to 5R25HL106365-12 from the National Institutes of Health PRIDE Program, DK020593, Vanderbilt Diabetes and Research Training Center for DRTC Alzheimer's Disease Pilot & Feasibility Program. CZI Science Diversity Leadership grant number 2022-253529 from the Chan Zuckerberg Initiative DAF, an advised fund of Silicon Valley Community Foundation (to Antentor Hinton Jr.). NIH T32GM137863, NIH GM T34GM136450 and NIH R25GM116707 (to Maria Elena Zavala). Burroughs Wellcome Fund grant number 1021868.01 and Ad-Hoc.

ORCID

Arnaldo Diaz Vazquez  <https://orcid.org/0000-0002-6653-1969>

Antentor Hinton  <http://orcid.org/0000-0002-7730-952X>

TWITTER

Antentor Hinton  @phdgpotein86

REFERENCES

- AlQaisi, R. (2022). *Pell dollars left on the table*. National College Attainment Network.
- Barongan, T., Neikirk, K., Shao, B., Vue, N., Spencer, E. C., Kabugi, K., Conley, Z., Vang, L., Vue, M., Vang, N., Garza-Lopez, E., Crabtree, A., Alexander, S., Dal, A., Beasley, H. K., Marshall, A. G., Killion, M., Stephens, D. C., Martinez, D., ... Hinton, A. (2023). Project strengthen: An STEM-focused career development workshop to prepare underrepresented minority students for graduate school. *Isience*, 26(10).
- Bettinger, E., & Baker, R. (2011). *The effects of student coaching in college: An evaluation of a randomized experiment in student mentoring*. NBER working paper No. 16881. National Bureau of Economic Research.
- Cahalan, M. W., Addison, M., Brunt, N., Patel, P. R., Vaughan, III, T., Genao, A., & Perna, L. W. (2022). *Indicators of higher education equity in the united states: 2022 Historical trend report*. Pell Institute for the Study of Opportunity in Higher Education.
- Canning, E. A., LaCosse, J., Kroeper, K. M., & Murphy, M. C. (2020). Social psychological and personality. *Science*, 11, 647.
- Chaney, B. W. (2010). *National evaluation of student support services: Examination of student outcomes after six years (Final Report)*. Office of Planning, Evaluation and Policy Development, US Department of Education.
- Clance, P. R., & Imes, S. A. (1978). The imposter phenomenon in high achieving women: Dynamics and therapeutic intervention, *Psychotherapy: Theory, Research & Practice*, 15(3), 241.
- Crabtree, A., Neikirk, K., Marshall, A., Barongan, T., Beasley, H. K., Lopez, E. G., Stephens, D., Murray, S., Spencer, E. C., Martinez, D., Vang, C., Jenkins, F., Damo, S., & Vue, Z. (2023). Strategies for change: thriving as an individual with a disability in STEM. *Pathogens and Disease*, 81, ftac045.
- Dokuka, S., Valeeva, D., & Yudkevich, M. (2020). How academic achievement spreads: The role of distinct social networks in academic performance diffusion. *PLoS One*, 15, e0236737.
- Fry, R. (2021). First-Generation college graduates lag behind their peers on Key economic outcomes. *Pew Research Center*.
- Gamez-Vargas, J., & Oliva, M. (2013). Adult guidance for college: Rethinking educational practice to foster socially-just college success for all. *Journal of College Admission*, (221).
- Garrison, N. J., & Gardner, D. S. (2012). *Assets first generation college students bring to the higher education setting*. Online Submission.
- Havlik, S., Pulliam, N., Malott, K., & Steen, S. (2020). Strengths and struggles: First-generation college-goers persisting at one predominantly white institution. *Journal of College Student Retention: Research, Theory & Practice*, 22(1), 118–140.
- Hefner, J., & Eisenberg, D. (2009). Social support and mental health among college students. *American Journal of Orthopsychiatry*, 79, 491–499.
- Hinton, Jr., A. O., McReynolds, M. R., Martinez, D., Shuler, H. D., & Termini, C. M. (2020). The power of saying no. *EMBO Reports*, 21, e50918.
- Hinton, Jr., A. O., Termini, C. M., Spencer, E. C., Rutaganira, F. U. N., Chery, D., Roby, R., Vue, Z., Pack, A. D., Brady, L. J., Marshall, A. G., Lewis, S. C., Shuler, H. D., Taylor, B. L., McReynolds, M. R., Palavicino-Maggio, C. B., & Garza-Lopez, E. (2020). Patching the leaks: Revitalizing and reimagining the STEM pipeline. *Cell*, 183, 568–575.
- Horowitz, J. M., Igielnik, R., & Kochhar, R. (2020). Most Americans say there is too much economic inequality in the US, but fewer than half call it a top priority. *Pew Research Center*, 9.
- LeBouef, S., & Dworkin, J. (2021). First-generation college students and family support: A critical review of empirical research literature. *Education Sciences*, 11, 294.
- Marshall, A., Pack, A. D., Owusu, S. A., Hultman, R., Drake, D., Rutaganira, F. U. N., Namwanje, M., Evans, C. S., Garza-Lopez, E., Lewis, S. C., Termini, C. M., AshShareef, S., Hicsasmaz, I., Taylor, B., McReynolds, M. R., Shuler, H., & Hinton, A. O. (2021). Responding and navigating racialized microaggressions in STEM. *Pathogens and Disease*, 79, ftab027.

- Marshall, A. G., Brady, L. J., Palavicino-Maggio, C. B., Neikirk, K., Vue, Z., Beasley, H. K., Garza-Lopez, E., Murray, S. A., Martinez, D., Shuler, H. D., Spencer, E. C., Morton, D. J., & Hinton, A. J. (2022). The importance of mentors and how to handle more than one mentor. *Pathogens and Disease*, 80, ftac011.
- Marshall, A. G., Palavicino-Maggio, C. B., Neikirk, K., Vue, Z., Beasley, H. K., Garza-Lopez, E., Murray, S. A., Martinez, D., Crabtree, A., Conley, Z. C., Vang, L., Davis, J. S., Powell-Roach, K. L., Campbell, S., Dal, A. B., Shao, B., Alexander, S., Vang, N., Vue, N., ... Hinton, Jr., A. (2022). Using champion-oriented mindset to overcome the challenges of graduate school: Impact of workshop for graduate school skills on underrepresented minority retention. *Pathogens and Disease*, 80, ftac024.
- Marshall, A. G., Vue, Z., Palavicino-Maggio, C. B., Neikirk, K., Beasley, H. K., Garza-Lopez, E., Murray, S. A., Martinez, D., Crabtree, A., Conley, Z. C., Vang, L., Davis, J. S., Powell-Roach, K. L., Campbell, S., Brady, L. J., Dal, A. B., Shao, B., Alexander, S., Vang, N., ... Hinton, Jr., A. (2022a). An effective workshop on "how to be an effective mentor for underrepresented STEM trainees. *Pathogens and Disease*, 80, ftac022.
- Marshall, A. G., Vue, Z., Palavicino-Maggio, C. B., Neikirk, K., Beasley, H. K., Garza-Lopez, E., Murray, S. A., Martinez, D., Crabtree, A., Conley, Z. C., Vang, L., Davis, J. S., Powell-Roach, K. L., Campbell, S., Brady, L. J., Dal, A. B., Shao, B., Alexander, S., Vang, N., ... Hinton, Jr., A. (2022b). The role of mentoring in promoting diversity equity and inclusion in STEM education and research. *Pathogens and Disease*, 80, ftac019.
- Mays, A., Byars-Winston, A., Hinton, A., Marshall, A. G., Kirabo, A., August, A., Marlin, B. J., Riggs, B., Tolbert, B., Wanajalla, C., Womack, C., Evans, C. S., Barnes, C., Starbird, C., Williams, C., Reynolds, C., Taabazuing, C., Cameron, C. E., Murray, D. D., ... Clemons, W. M. (2023). Juneteenth in STEM and the barriers to equitable science. *Cell*, 186, 2510–2517.
- Murray, S. A., Davis, J., Shuler, H. D., Spencer, E. C., & Hinton, A. (2022). Time management for STEM students during the continuing pandemic. *Trends in Biochemical Sciences*, 47, 279–283.
- Murray, S. A., Hinton, A., & Spencer, E. C. (2022). Developing cultural humility in immunology and STEM mentoring. *Trends in Immunology*, 43, 259–261.
- NASFAA. (2021). Issue Brief: Doubling the maximum pell grant. Updated in August 2022. NASFAA. https://www.nasfaa.org/issue_brief_double_pell#:~:text=Doubling%20the%20maximum%20Pell%20Grant%20to%202413%2C000%20will%20effectively%20recalibrate,college%20is%20also%20a%20struggle
- Neikirk, K., Barongan, T., Rolle, T., Garza Lopez, E., Marshall, A., Beasley, H. K., Crabtree, A., Spencer, E. C., Shuler, H., Martinez, D., Murray, S., Vang, C., Jenkins, F., Damo, S., & Vue, Z. (2023). Using quotients as a mentor to facilitate the success of underrepresented students. *Pathogens and Disease*, 81, ftad008.
- Noel, J. K., Lakhan, H. A., Sammartino, C. J., & Rosenthal, S. R. (2023). Depressive and anxiety symptoms in first generation college students. *Journal of American College Health*, 71(6), 1906–1915.
- O'Brien, E. M., & Zudak, C. (1998). Minority-Serving institutions: An overview. *New Directions for Higher Education*, 102, 5–15.
- Olfert, M. D., Hagedorn-Hatfield, R. L., Houghtaling, B., Esquivel, M. K., Hood, L. B., MacNell, L., Soldavini, J., Berner, M., Savoie Roskos, M. R., Hingle, M. D., Mann, G. R., Waity, J. F., Knol, L. L., Walsh, J., Kern-Lyons, V., Paul, C., Pearson, K., Goetz, J. R., Spence, M., ... Coleman, P. (2021). Struggling with the basics: Food and housing insecurity among college students across twenty-two colleges and universities. *Journal of American College Health*, 1–12.
- Quinn, D. M., Camacho, G., Pan-Weisz, B., & Williams, M. K. (2020). Visible and concealable stigmatized identities and mental health: Experiences of racial discrimination and anticipated stigma. *Stigma and Health*, 5, 488–491.
- Redford, J., & Mulvaney, K. (2017). *First generation and continuing-generation college students: A comparison of high school and postsecondary experiences*. U.S. Department of Education.
- Rehr, T. I., Regan, E. P., Abukar, Z., & Meshelemiah, J. C. A. (2022). Financial wellness of first-generation college students. *College Student Affairs Journal*, 40, 90–105.
- Rice, A. J., Colbow, A. J., Gibbons, S., Cederberg, C., Sahker, E., Liu, W. M., & Wurster, K. (2017). The social class worldviews of first-generation college students. *Counselling Psychology Quarterly*, 30, 415–440.
- Royster, P., Gross, J., & Hochbein, C. (2015). Timing is everything: Getting students back on track to college readiness in high school. *The High School Journal*, 98, 208–225.
- Schuyler, S. W., Childs, J. R., & Poynton, T. A. (2021). Promoting success for first-generation students of color: The importance of academic, transitional adjustment, and mental health supports. *Journal of College Access*, 6(1), 12–25.
- Scott-Clayton, J., & Zafar, B. (2019). Financial aid, debt management, and socioeconomic outcomes: Post-college effects of merit-based aid. *Journal of Public Economics*, 170, 68–82.
- Shuler, H., Cazares, V., Marshall, A., Garza-Lopez, E., Hultman, R., Francis, T.-K., Rolle, T., Byndloss, M. X., Starbird, C. A., Hicsasmaz, I., AshShareef, S., Neikirk, K., Johnson, P., Vue, Z., Beasley, H. K., Williams, A., & Hinton, A. (2021). Intentional mentoring: Maximizing the impact of underrepresented future scientists in the 21st century. *Pathogens and Disease*, 79, ftab038.
- Shuler, H. D., Spencer, E. C., Davis, J. S., Damo, S., Shakespeare, T. I., Murray, S. A., Lee, D. L., & Hinton, A. (2022). Learning from HBCUs: How to produce black professionals in STEM. *Cell*, 185(16), 2841–2845.
- Soria, K. M., Kelling, C., Mossinghoff, M., & Beahm, R. (2022). First-generation college students' mental health during the COVID-19 pandemic. *Journal of First-generation Student Success*, 2, 97–117.
- Tang, X., Li, Y., Duan, W., Mu, W., & Cheng, X. (2019). Character strengths lead to satisfactory educational outcomes through strength use: A longitudinal analysis. *Frontiers in Psychology*, 10, 1829.
- Termini, C. M., McReynolds, M. R., Rutaganira, F. U. N., Roby, R. S., Hinton, Jr., A. O., Carter, C. S., Huang, S. C., Vue, Z., Martinez, D., Shuler, H. D., & Taylor, B. L. (2021). Mentoring during uncertain times. *Trends in Biochemical Sciences*, 46, 345–348.
- Thomas, E. P., Farrow, E. V., & Martinez, J. (1998). A TRIO program's impact on participant graduation rates: The Rutgers university student support services program and its network of services. *The Journal of Negro Education*, 67, 389.
- Vue, Z., Vang, C., Vue, N., Kamalumpundi, V., Barongan, T., Shao, B., Huang, S., Vang, L., Vue, M., Vang, N., Shao, J., Coombes, C., Katti, P., Liu, K., Yoshimura, K., Biete, M., Dai, D.-F., Phillips, M. A., & Behringer, R. R. (2023). Asian Americans in STEM are not a monolith. *Cell*, 186, 3138–3142.
- Wolff, H.-G., & Moser, K. (2009). Effects of networking on career success: A longitudinal study. *Journal of Applied Psychology*, 94, 196–206.

How to cite this article: Kamalumpundi, V., Silvers, S., Franklin, L., Neikirk, K., Spencer, E., Beasley, H. K., Wanajalla, C. N., Vue, Z., Crabtree, A., Kirabo, A., Gaddy, J. A., Damo, S. M., McReynolds, M. R., Odie, L. H., Murray, S. A., Zavala, M. E., Vazquez, A. D., & Hinton Jr., A. (2024). Speaking up for the invisible minority: First-generation students in higher education. *Journal of Cellular Physiology*, 1–8. <https://doi.org/10.1002/jcp.31158>