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Queer science: Temporality and futurity for queer students in STEM

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Abstract

The sociopolitical landscape for queer people has changed dramatically in recent decades; however, progress has been both halting and uneven. While this is evident in many areas of professional and private life, this study focuses on the

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experiences of queer students in STEM learning environments in US colleges and universities. Specifically, we explore student expressions of temporality and futurity with regards to their STEM experiences and aspirations. Engagement with queer theory, especially queer formulations of time and space, alerted us to the importance of sociopolitical developments of the past several decades—particularly the rise and entrenchment of neoliberal politics in both academic STEM arenas and gay and queer politics. Engaging with queer temporality and spatiality, neoliberalism, and the homonormative turn, we found three interdependent themes: (1) the (re)negotiation of queer politics within academic disciplines linked to the neoliberal state; (2) the multiple bifurcations of self, time, and space required to simultaneously navigate queerness and STEM; and (3) the development of utopian projections of the future intended to reconcile queer identity, neoliberalism, and STEM. These findings point to a tension between queer identities and STEM fields arising not from the nature of the fields themselves but from science's interconnectedness with a neoliberal economy. This tension not only structures participants' current experiences in STEM learning spaces but also flavors the way they consider their futures as queer scientists.

Keywords
Queer theory, temporality, STEM, postsecondary education, futurity, neoliberalism

The US sociopolitical landscape for people with minoritized identities of sexuality and/or gender (MIoSG; Vaccaro et al., 2015) has dramatically changed in the past several decades—including in science, technology, engineering, and mathematics (STEM) fields and learning environments. Following the AIDS crisis' peak in the mid-1980s, social, political, and legal developments, such as increased awareness of and legislation about hate crimes in the wake of the murders of Matthew Shepard and Brandon Teena, the legalization of gay marriage, and the repeal of Don't Ask, Don't Tell, are both the consequences and producers of increased visibility of people with MIoSG. Progress over time, however, has proven to be both normative and uneven. Much of the safety and security is experienced by white, cisgender, middle-class gay, or lesbian people, while trans and gender nonconforming people, especially queer and trans People of Color, are significantly more likely to be the victims of discrimination and violence (National Coalition of Anti-Violence Programs, 2019; Ray et al., 2018).

Our work, which examines the experiences of contemporary MIoSG college students, is situated within not only this queer historical timeline, but also within particular spaces—namely, STEM settings (departments, classrooms, and laboratories) on college campuses. STEM spaces—including disciplines, college curricula, and learning spaces—have historically resisted queer theory, especially

given queer theory's traditional focus on cultural and artistic production. Researchers and theorists have only recently begun to bring a queer lens to understanding STEM majors and the construct and culture of STEM itself (e.g., Miller et al., 2020; Parson, 2016). In this study, we explore how the discursive processes and experiences that shape people's understandings of STEM impact the ways that MIoSG students in STEM understand and construct their own temporality and futurity. To do so, we extend prior theorizing about queer futurity and temporality in order to understand how our participants complicate these theorizations—particularly in their more normative constructions of the future and as atypical subjects for queer theorization. In other words, while scholars of queer temporality and futurity have focused on distinctly queer communities, we ask how does engagement with a normative field (like STEM) change the way that MIoSG people experience time, temporality, and futurity?

This study is part of a larger study that examines the STEM experiences of MIoSG participants with diverse gender and sexual identities, varied STEM majors and aspirations, and four different institutions in two different geographic locales (Vaccaro et al., in press). We found that MIoSG students engaged in a complex process of historicized meaning making that connected students' past, present postsecondary experiences to predictions about their futures (Vaccaro et al., in press). The current study starts with our interest in the process of historicized meaning making and extends it to think about how the experiences of MIoSG students in STEM can contribute to queer theorizing about time and space. We engage scholarly debates about queer futurity to understand how participants imagine their futures as MIoSG scientists as well as to explore the utopian potentialities of queer identities in STEM.[1]

Sensitizing constructs

Consistent with constructivist grounded theory (Charmaz, 2014), we reviewed literature on queer temporality and utopias, queer spatiality, queerness in STEM, and the impact of neoliberalism to explore queer futurity for MIoSG students in STEM. While queer theory typically focuses on more radical cultural, political, and artistic productions than STEM, we believe that juxtaposing queer futurity with this conservative STEM space offers a prime opportunity for thinking about temporality. In other words, while queer theory does not directly describe STEM spaces, the effort to apply it opened new doors to understanding the experiences of MIoSG students therein and offered important lessons about queer theory itself.

Queer temporality

Time and temporality have long interested queer theorists. Although many theorists take an antirelational stance towards queer futurity (e.g., Bersani, 2010;

Edelman, 2004), queer utopians like Freeman (2010) and Halberstam (2005) have argued that queer subcultures create time and space outside of heteronormative rhythms of reproduction, work, and capitalism. Freeman's (2010) work is invested from the very beginning in the hope for a queer future as she explicitly argued against Edelman to propose "queer temporalities…[as] points of resistance that, in turn, propose other possibilities for living in relation to indeterminately past, present, and future others…" (xxii). In this framing, capitalism and heteronormativity also produce chrononormativity, "or the use of time to organize individual human bodies toward maximum productivity," and chronobiopolitics, "the sexual arrangement of the time of life of an entire population" (Freeman, 2010: 3). Queerness, in contrast, produces temporalities outside of these norms, due to its historical existence outside of both typical human reproductive cycles and "normal" work lives, which in turn produce new possibilities for future community (Freeman, 2010). The temporalities that she charts are complicated by changing realities for queer people, especially the increased viability of living a queer life and the ever-increasing access to chrononormativity for MIoSG people (Freeman, 2010).

Halberstam (2005) similarly posited that "queer uses of time and space develop, at least in part, in opposition to the institutions of family, heterosexuality, and reproduction" (1). Identifying the enormous impact of the AIDS epidemic on queer culture, Halberstam (2005) emphasized queerness's radical possibilities and alternatives rather than its destructive impulses (Edelman, 2004). Additionally, Halberstam (2005) gave queerness an expansive definition, writing that "'queer' refers to nonnormative logics and organizations of community, sexual identity, embodiment, and activity in space and time" and that "queer time" and "queer space" refer to the temporalities and "place-making practices" produced by these communities (6). Much like Freeman's and Muñoz's work, Halberstam (2005) is deeply interested in subcultural lives, with their "transient, extrafamilial, and oppositional models of affiliation" (153–154), especially in their opposition to the rise of middle-class MIoSG people who engage in more traditional forms of family.

Even more so than Freeman and Halberstam, Jones (2013) and Muñoz (2009) traffic in utopian hopes for queer futurity. It is important to note that neither of these theorists are advocating for teleological or abstractly idealistic utopias (Jones, 2013; Muñoz, 2009). Rather they are drawing on critical idealism and the notion that "concrete utopias are relational to historically situated struggles, a collectivity that is actualized or potential" (Muñoz, 2009: 3). Similarly, Jones (2013) contended that queer utopias are not predicated on perfection for everyone, but instead "[make] life more bearable in the present because in doing so we create the potential for a better future" (2). This very potentiality—especially for a "future not constructed by the dictates of American neoliberalism, but by the needs and desires of queer people"—is constitutive of queer futurity in that

"potentialities…although they are present…do not exist in the present but, more nearly, in the horizon" (Jones, 2013: 11–12).

Muñoz's (2009) queer of color critique situated queerness as a position that is always oriented toward the future—he posited that "queerness is a longing that propels us onwards, beyond romances of the negative and toiling in the present…queerness is essentially about the rejection of a here and now and an insistence on potentiality or concrete possibility for another world" (1). This vision is utopian because it is not simply yearning for a better future for queer people, but positing the existence of new and uncharted worlds that may be constituted through queer communities and racial liberation (Muñoz, 2009). Notably, this framing resituates queer futurity away from hegemonic whiteness in its future-making possibilities—an important challenge to the normative chronobiopolitics sometimes embedded in constructions of queerness.

Queer spatiality

Conceptualizations of queer space and spatiality describe environments where queer people can be located. However, there is not scholarly consensus on how to identify those spaces due to changing definitions over time. Oswin (2008) noted that early queer theorizing, which is not entirely displaced by later work, situated queer space as primarily gay and lesbian environs. This framing treats these spaces as specific locations "carved out by sexual dissidents…that resist and rupture the hegemonic heterosexuality that is the source of their marginality and exclusion" (Oswin, 2008: 90). More recent work, however, challenges this conceptualization by rejecting its emphasis on physical space, gay and lesbian subjects (to the detriment of bisexual, trans, and queer people), and the primacy of sexuality for raced, classed, and gendered bodies (Oswin, 2008). Importantly, many conceptualizations of queer space are binarist, focusing on the division of queer space from straight space (Oswin, 2008).

Queer theories that consider the entanglement of time and space also rest, often implicitly, on this same queer/straight binary, which can also complicate normative understandings of public/private space. As discussed previously, queer theory often situates queerness as outside of typical life paths. Freeman's (2010) chrononormativity and chronobiopolitics, while referring predominantly to temporality, also implicitly refer to spaces; if chronobiopolitics are centered on heterosexual norms of family and work life, then both the private spaces where family life occurs and the public spaces of the workplace can be taken as implicitly heterosexual. This framing points to the ways that chrononormativity and heteronormativity can work to encompass all available space. Similarly, Halberstam's (2005) definition of queer communities designates queer place- and community-making practices and spaces as outside of typical familial formations. Queer spaces and places can often be public or semipublic and lack the capital

inherent in normative affiliations to capitalism, family, and domesticity. Muñoz (1999) additionally complicates queer/straight and public/private binaries as disidentificatory practices for queers of color to highlight the way that public spheres are also predominantly white spheres—indeed, white queer spaces are just as hostile to queers of color as straight spaces. The net effect of this queer theorizing of space is a recognition that neither public nor private spheres offer a stable queer space. As Oswin (2008) notes, this formulation makes it critical to work to deconstruct a strict straight/queer binary as well as to understand how spatial normativities of sexuality work with race, class, and gender in terms of power.

Queerness in STEM

A small but growing body of research shows MIoSG students experience exclusion in postsecondary STEM environments (Cech et al., 2017; Hughes, 2017; Linley et al., 2018; Mattheis et al., 2019). Most prior studies have focused on a single discipline at a single point in time (e.g., Atherton et al., 2016; Cooper and Brownell, 2016; Cech et al., 2017; Hughes, 2017). Across studies, participants reported a lack of discussion and visibility of LGBTQ people and topics in STEM (Hughes, 2017; Mattheis et al., 2019) and discomfort being open about LGBTQ identities (Atherton et al., 2016; Bilimoria and Stewart, 2009; Cooper and Brownell, 2016). In this environment, nondisclosure and selective disclosure identities appeared to be the norm, prompting people to spend time and energy assessing their safety and the consequences for being "out" (Cech and Waidzunas, 2011; Mattheis et al., 2019). Consequently, compartmentalization—separation of one's gender and/or sexuality identity and identity as a scientist, engineer, or STEM professional—also became a norm (Hughes, 2017; Mattheis et al., 2019).

Researchers have recently begun to explore the experiences of MIoSG students across STEM disciplines. Drawing from national, longitudinal survey data, Hughes (2018) found that LGBTQ students are 8% less likely to persist in STEM after 4 years in college (i.e., students are still enrolled in college but switched to a non-STEM major) than their heterosexual counterparts. However, LGBTQ students more likely to participate in undergraduate research opportunities. As of yet, limited qualitative evidence is available to understand how MIoSG students make meaning of these experiences across disciplines.

Neoliberalism in STEM and queer theory

Neoliberalism, which started as economic policy in the 1970s, can be broadly understood as a redefinition of the purpose of social institutions, such as higher education, to focus on private, rather than the public, good (Aronowitz, 2000; Slaughter and Rhoades, 2004). Shrinking public investment in education

combined with the commodification, commercialization, and marketization of higher education have resulted in an increased emphasis on economic efficiency; hiring temporary, low-wage employees; viewing students as customers; and revenue generation through donor appeals and research-industrial partnerships (Slaughter and Rhoades, 2004). As institutions change to emphasize entrepreneurship and commercialization, individuals within them also exhibit competitive and acquisitive orientations (Carter, 2017), which Halberstam (2005) notes are distinctly non-queer.

STEM fields have become closely entwined with neoliberalism over the past several decades. Although neoliberalism was not the first ideology to link science and the economy, its imbrication of science, economic advancement, and global competition have fundamentally remade the scientific enterprise in higher education (Carter, 2017). The effect on students in STEM is profound; neoliberalism has brought a narrow focus on products to STEM departments wherein students get treated as future products for sale to the workforce (Carter, 2017; Slaughter and Rhoades, 2004). Thus, students are both constructed to be consumers/customers of higher education institutions as well as products groomed for the private sector workforce or further neoliberal knowledge production in academia. In this way, neoliberal science remakes the educational experience for students; careerism and work-readiness permeates departments, majors, and courses at almost every level.

Neoliberalism is also deeply intertwined with the depoliticization of science and white supremacy (Cech, 2013; Cech and Sherick, 2015; Le and Matias, 2019; McGee, 2016). Depoliticization frames social and cultural topics, such as LGBTQIA+ rights or issues of social justice and equity, as tangential to scientific and engineering work (Cech, 2013; Cech and Sherick, 2015). White supremacy not only structures inclusion and exclusion in STEM, but it is also a necessary condition for neoliberalism. Combined with neoliberalism's focus on privatization, depoliticization and white supremacy structure STEM academic environments to prize technical expertise and avoid engagement with social issues in classes, labs, and other learning spaces.

Queer theorists have also grappled with neoliberalism's effects, and although STEM is rarely discussed in queer theoretical scholarship, many theorists are concerned about the impact of changing neoliberal politics on queer people, futures, and potentiality. Lisa Duggan coined the term "homonormativity" to describe neoliberalism's sexual politics, identifying them as "centrist, assimilationist, [and] against extremism on both the right and the left" (Duggan, 2002: 176). Duggan (2002) described the "new homonormativity" as "a politics that does not contest dominant heteronormative assumptions and institutions but upholds and sustains them while promising the possibility of a demobilized gay constituency and a privatized, depoliticized gay culture anchored in domesticity and consumption" (179). These homonormative politics also reflect whiteness,

white supremacy, and respectability politics. They have rejected radical queer politics and embraced neoliberalism, with effects Duggan (2002) argues are dire:

> "equality" becomes narrow, formal access to a few conservatizing institutions, "freedom" becomes impunity for bigotry and vast inequalities in commercial life and civil society … All of this adds up to a corporate culture managed by a minimal state, achieved by the neoliberal privatization of affective as well as economic and public life. (190)

Normativity is the thread that ties queer temporality, queer spatiality, and the neoliberal. Queer time and space take place outside of heteronormative—and now homonormative—reproductive, familial, and work patterns. This study looks at the ways that MIoSG students experience time, space, and utopian futurity vis-à-vis STEM majors and careers.

Methods

We developed this study from a constructivist grounded theory study of MIoSG students in STEM at multiple higher education institutions (Vaccaro et al., in press). The main research question for this research was how do MIoSG students majoring in STEM experience and navigate campus learning environments and their disciplines/fields? Charmaz (2014) contends that grounded theorists should use their analyses "to critique earlier studies and theories and to make comparisons to these materials" (305). Our data analysis yielded findings related to temporality which led us to revisit and question queer theories. In this manuscript, we use data regarding temporality to engage and reframe classic queer theoretical writings.

Participants

Project data were collected in the United States at three Northeastern (two public and one private) and one public Southeastern higher education institutions. We utilized theoretical sampling (Charmaz, 2014) to glean a diverse pool of students with MIoSG. We sent electronic recruitment flyers to STEM departments, LGBTQ student organizations, and LGBTQ centers. Flyers explained that we were recruiting LGBTQIA+ and/or MIoSG students in STEM. All 56 volunteers who fit these criteria were included in the study. They included 51 undergraduates and five graduate students. Participants self-reported one or more gender and sexual identities in an open-ended field. Participant gender identities included man (24), woman (18), cisgender (14), transgender (7), genderqueer (6), non-binary (5), female (4), male (2), and agender (1). Participant sexual identities included gay (22), bisexual (18), pansexual (11), lesbian (7), asexual (4), queer (4), questioning (3), gray-asexual (2), dyke (1), gynophile (1), homoromantic (1),

panromantic (1), straight (1), and woman-loving-woman (1). Nearly 20% of our sample self-identified as students of color—including: 4 Latinx, 4 Black, 2 Asian American, 1 Arab/North African, 2 bi/multiracial, 2 Native American, 1 South Asian, and 45 white students. Since our collection sites were historically white institutions, these racial demographics mirrored (or were slightly larger than) the campus populations of students of color. Participants majored in engineering (29), computer science (9), biology (5), food science and nutrition (4), environmental science (2), marine science (2), neuroscience (2), kinesiology (1), mathematics (1), and natural resources (1). 12 participants reported having a disability.

Data collection and analysis

We used semi-structured, audio-recorded individual interviews. Although the precise phrasing and sequencing varied by interview, our protocol began with inquiries into participants' backgrounds (e.g., "Tell me about yourself" and "On the demographic form, you indicated you identified as [Gender/Sexuality]. Would you please tell me a bit about what that means to you?"). The protocol then moved to questions about STEM experiences (e.g., I'd like to ask you to tell me a little bit more about what it's like to be [Gender/Sexuality] in [Field]), experiences in specific campus environments (e.g., buildings, areas of campus, and classrooms), and interactions with people (e.g., STEM peers, faculty, staff, and internship supervisors). Participants reflected on past events, described current experiences, and made predictions about their futures. Taken together, student narratives illuminated the historicized nature of student meaning making and led us to develop an emerging model, presented elsewhere (Vaccaro et al., in press). This study delves into student insights about time and space and contrasts their perspectives with notions of temporality, futurity, and spatiality as described in queer theory (Freeman, 2010; Halberstam, 2005; Jones, 2013; Muñoz, 2009).

Following constructivist grounded theory, we analyzed data concurrently with collection—using constant comparative analysis (CCA) to structure this process (Charmaz, 2014). For this project, CCA was supported by intentional memoing (Charmaz, 2014) by researchers after and between interviews. During CCA, we assigned more than 100 initial codes to sort and organize data into manageable segments. Then, we used selective and focused codes to narrow our analysis. Focused coding helps identify important segments of data that require further analysis and theorizing (Charmaz, 2014). For this study, we focused our attention on segments of the data related to time and space.

Study quality

We utilized multiple strategies to enhance research quality including analytic triangulation, discrepant case analysis, member checking, and expert reviews

(Morrow, 2005). We used analytic triangulation to compare interview transcripts from different campuses and focus group data and researcher memos. We used discrepant case analysis to ensure that focused codes related to temporality and spatiality accurately reflected the realities of all students from diverse majors, races, genders, and sexualities. All participants were invited to attend a member-checking focus group—which is a collective space for participants to question, challenge, and extend researcher interpretations while building off one another's reactions. 17 participants attended one of five member-checking focus groups where we presented preliminary study findings and invited students' feedback. All focus group participants believed that our conclusions captured their experiences, with one concluding: "That really sums it right up." We also invited 25 gender, sexuality, and STEM experts to review our emergent categories, and those experts offered positive feedback about our work.

To address relational competence, we regularly met to have reflective discussions about our social identities, positionality, power relationships, pre-understandings, and findings (Charmaz, 2014). All of the researchers are active in social justice work on and off campus and four authors of this study self-identify as people with minoritized sexual identities. Scholars have argued that LGBTQ researchers can have insider knowledge and terminology that can establish rapport and facilitate recruitment and data collection (LaSala, 2003). This seemed to be the case in this study. Our MIoSG likely had some influence on a rapid response to our call for participants as well as the candor with which students shared their rich and sometimes painful experiences and perspectives. During the study, we used ongoing process consent and revisited our commitment to confidentiality to mitigate power differentials (Morrow, 2005).

Findings

Participants in our study revealed the fundamental tensions involved in the development of affirmative understandings of self and construction of the multiple identities (e.g., gender, sexuality, and scientist) frequently engaged by students with minoritized identities of sexuality and gender in STEM. Our findings fall broadly into three interdependent themes: (1) The (re)negotiation of queer politics within academic disciplines fundamentally linked to the neoliberal state, (2) the multiple bifurcations of self, time, and space required to simultaneously navigate queerness and STEM, and (3) the development of utopian projections of the future intended to reconcile queer identity, neoliberalism, and STEM. Collectively, these findings point to a tension between queer identities and STEM fields arising not from the nature of the fields themselves, but from science's interconnectedness with a neoliberal sociopolitical economy.

Queer politics and neoliberalism

The participants in our study consistently described the way that they both thought about and represented their sexual and gender identities within the depoliticized contexts of STEM disciplines as well as the broader sociopolitical realities of the institutions within which they worked. For example, Caroline, a cisgender, gay woman, described her sexuality by noting that "I have a girlfriend and I've really only dated women." However, Caroline also resisted using any specific label to describe her sexuality and linked this decision to a reluctance to disclose within her field. She went on to state:

> I don't think we need titles, and even in the field I have been here since 2012, now it's 2018, and I really never told anybody that I've had a girlfriend until my second semester of my graduate career, which was last spring. And so just being from the South. I just don't want to identify, I guess. I don't want to label myself. My dad's twin is also gay and he was also one of the first people I told and…I tell him about how I live in [my neighborhood] and how I'm so happy there's [a] really large population of gay and homosexual and queers and trans and just very accepting environment.

In this excerpt, Caroline clearly indicates that her reluctance to label stems from the recognition that describing her sexuality using one particular label is unnecessary within the "very accepting environment" of queer-identified people to whom Caroline has revealed her sexuality. However, she also directly links her romantic partnership with a woman both to her academic career—noting that she had not revealed that she was dating a woman until the second semester of her graduate program—and also to geography—noting that they were "from the South." In so doing, Caroline provides the template that most of our participants followed in describing the relationship between their identities, politics, and the broader sociopolitical economy within which STEM fields are embedded. In these learning environments' neoliberal and depoliticized atmospheres, students situated conversations about identity—an inherently political category—as outside of STEM.

Although many of our participants actively thought about how their gender and sexual identities fit within their academic disciplines, they did not do so with a uniform attention to the political realities of queerness. Gareth, a White gay man, provides a particularly good example of the deliberate depoliticization of sexuality and gender when he notes that:

> Being gay is not who I am. I guess you could say it's what I am. It's just another part of me. When you ask who I am, I would probably sit there and say I'm a mechanical engineering major with a concentration on energy and the passion to change the

> world, but I just happen to gay. It's like Tim Cook. You ask him who he is, "Well, I'm the CEO of Apple, and I just happen to be gay." I would say very similar right there. Not to speak for him but ... It's the way I see it.

In this example, Gareth utilizes perhaps the most visible queer-identified person in the corporate world as both a role model and mechanism to express their sexuality, which they view as subordinate to their disciplinary identity as well as to the corporate structure to which it is attached. It is additionally important to note that both Caroline and Gareth could fall back on both their cisgender identities and their white identities in these spaces, an affordance unavailable to Students of Color with MIoSG.

Although Gareth's narrative did not provide insight as to whether he, too, experienced pressures to neutralize his sexuality to conform to neoliberal pressures for productivity and performance, other participants linked the two—suggesting that a person's public presentation of sexual and gendered selves might be different than their self-understandings. For instance, Luna noted how her STEM field actively sought people's silence. Luna, a femme-aligned, multiracial lesbian, noted:

> Every time I tell somebody I'm a women and gender studies minor and a computer science major, they're like, "Oh, why would you do that [pursue a women and gender studies minor]? Why would you even think of that?" I usually say, "The fact that you have to ask that as a question speaks for itself."

Although Gareth's account depoliticized and decontextualized his own sexuality, Luna's account makes clear that decisions about representation of self are political and made within a very specific context in which identifying ways potentially perceived by others as problematic can have real consequences. Luna connected her choice of minor with her own identities that she felt pressure to defend her academic choices to her compatriots in STEM speaks to the ways that these spaces deter identity-based exploration. These decisions are also not made in a vacuum; rather, students use complex understandings of time and space to understand, and often compartmentalize, their queer selves. These findings also speak to the ways that broad historical trends, such as the turn to neoliberalism, have material effects on the lives, choices, and emotions of MIoSG students in STEM. They are not simply passive recipients of temporal developments; rather, they attempt to negotiate these effects and meanings for their own identities.

Queer selves, time, and space in the public and private spheres

In describing their navigation of STEM spaces, our participants also sought to differentiate their public and private presentations of sexuality and gender. They

typically suggested that they suppressed the presentation of their queer selves in STEM spaces and instead relegated those versions of themselves to more private, non-STEM spaces, which also necessitate different uses of time. In other words, we found that participants often practiced STEM time (time when they enacted a science role or identity) or queer time (time when they enacted queer roles or identities), but rarely did so at the same time. For example, Ana, a gay/bisexual/pansexual Black woman, described her efforts to ensure that, when in STEM spaces with her girlfriend, they were "not affectionate" and offered the following rationale: "I guess it's kind of like oh no my peers are here, we can't be too affectionate." However, Ana also offered that she did not self-police their behavior elsewhere on-campus—only when among "peers and who else would know me within that [STEM] major" and noted that "you can't be too gay" in her engineering field. Meanwhile, another student, Hazel, linked these representations of self within STEM to the broader sociopolitical economy and its effect on queer identity—noting that:

> Some people, if they're from maybe a smaller town may deal with being here and being queer differently than someone who is maybe from a more accepting town. I don't know. Maybe if I was in somewhere there's a big LGBT community, I may come here and not be as closed about my own sexuality for some people.

Hazel, like most of our participants, understood that queer identities have always been contested and regulated within the public sphere, but most of our participants took this idea a step further by suggesting the need to be extra-intentional about presentations of self within their STEM disciplines—spaces within which they otherwise typically felt at home.

This bifurcation of selves, spaces, and times had notable consequences for our participants and the way that they navigated STEM disciplines. Jack, a gay man, provided a particularly illustrative example in this regard. He noted that often, in order to ensure that people did not know he was gay, he would try to "act a specific way." Jack noted that this performance included: "alter[ing] my body language to be, I guess, more stiff" as well as not "us[ing] my hands for hand gestures" and "mak[ing] my voice a little bit deeper." Importantly, Jack actively constructed those behaviors he had internalized as stereotypically queer as unprofessional—noting that he engaged in this self-policing to "show that I'm more professional, and make people think of my professional sense instead of looking at me as who I am personally." Jack went on to note that this suppression of self meant that he was only out to his "closest friends" and also that they found the performance problematic—noting: "I hate that I do that. I hate that I change a little bit of how I act and things. But a lot of that just goes deep into just trying to avoid persecution as much as possible." Jack described these behaviors as antithetical to his self-concept and also indicated a belief that queerness would be seen as incompatible with his academic field.

These experiences were mirrored in the accounts of many of our participants; MIoSG students had to actively work to understand how they could fit into STEM spaces and times. In addition to demarcating time and practicing time differently, for many participants, doing so was a profound struggle that could only be reconciled by the creation of a hoped-for future in which these public and private versions of themselves and their uses of time might be more fully integrated. One participant, Reid, a gay man, provides a particularly illustrative but not unusual account:

> I'm starting to change where I want to go with my major. I definitely want to be in a position where I don't feel like I have to act differently between where I'm working and how I normally act, which is why I really like the idea of moving into either an education type of setting or just an area using my degree where I can be a lot more helpful or meet people who won't really care the fact that I'm gay. I think in some STEM fields right now, at least in the south … I think people would care if I was just much more open about my sexuality. I definitely don't want that to happen….As I get ready for that next point, finding out what I want to do, I definitely want to move into somewhere where I don't have to have that split between how I act when I'm around professionals or around people I work with and how I act when I'm just by myself. Obviously, you need to be professional in your job. You can't be acting like an idiot. . . but I don't want to have to feel like I'm putting on this, okay, this is my engineering stature. This is how I'm gonna act when I'm doing engineering stuff and this is how I'm gonna act when I'm trying to be more social … maybe some people can do that [and be] comfortable, but it just feels really uncomfortable for me and it really hurts my image 'cause it feels like I'm hiding and I don't like that feeling.

Reid's account makes clear just how troubling the need to reconcile one's gender or sexuality with an academic discipline perceived as hostile to it can be. In order to do so, Reid has to project a future workplace that might be more queer-friendly—or move elsewhere in the United States. Notably, both Reid and the majority of participants who used temporal or geographic projections to reconcile their sexuality and gender with their STEM disciplines noted elsewhere that they recognized the broader context for queer oppression in American society: they were not naive to the reality that they would encounter hostility in their future workplaces, but they needed to believe in better places or futures to make living in the present possible.

Thin Utopias: Queer futurity in STEM under neoliberalism

Our final finding focuses on the projections of futurity that our participants used to make sense of their present experiences. Notably, in contrast to prior literature on queer utopias, we found our participants engaged in starkly realistic, notably un-queer projections of futurity. They typically sought not a radical transformation of social reality or temporality, but rather to find a way to live within it.

For example, Jack described a desire to connect his STEM aspirations with values arising from their experiences as a gay, cisgender man:

> I don't see any of my career paths changing, but I do see myself being more open about who I am and getting more involved with issues concerning the LGBTQ community. So, in med. school, I really hope to get involved with professors and researchers who are doing research on big issues affecting the gay community, such as HIV or AIDS. I definitely don't see my sexuality as leading me to a different place, but I just see it as opening more opportunities for me in the places that I want to go. [. . .] I want to be able to . . . not really care what society thinks as much. I want to be who I am and be proud of that. I work on that every single day. There is, mostly every single week, there is a day where I get just a little bit further in that. Yeah, hopefully soon, I'll be able to be me and unequivocally me to everybody.

Notably, Jack describes a process of becoming more himself as he projects his future career and hopes to be able to integrate that with his self-understandings as a gay man. However, he does not seek the widespread re-construction of medicine or science—that is, a queer medicine or a queer science—but merely the possibility that Jack might be a queer person who is a doctor.

Although Jack described his goals particularly thoughtfully, his words reflect those of the majority of our participants. For example, Stella, a transwoman, succinctly noted: "I think I just won't pursue a job that won't allow me to be fully out." For Stella, this conviction stemmed from prior experience confronting prejudice and recognizing that nothing positive comes from the long-term suppression of self, which she described using the metaphor of a hole: "I don't want to dig myself through my whole life, just be digging a trench and then have to fill it all in later. That's just a waste of time." Here time is not only thought of as a future projection, but something that Stella might come to regret wasting—in other words, a finite resource of which she only has so much and which should not be used on unproductive endeavors.

Many students described futures that were modestly focused on fitting into the status quo, and unfortunately, for some participants that seemed impossible. For Reid, the engineer whose future hopes we briefly described above, uncertainty over the future led to the active contemplation of non-STEM spaces:

> So I definitely want to try and find a field that I can work in where I don't have to feel like I'm hiding. Where I can act like myself and be accepted because of that and if maybe someday that works in STEM, that becomes the norm, that would be great for me. At least right now if I was to be right out into it, I don't think I'd feel 100% confident that that would be the case. Which is why I've been drifting more towards maybe education or [working] in the university or something.

Only one participant, Kane, a gay, cisgender, Asian American/Pacific Islander, described a nonutopian version of this vision—noting that: "I just know that there have been, also, a bunch of studies where people who identify with LGBTQ+, they aren't treated as well either. [. . .] I'm not sure how I could prepare other than just hiding the fact that I'm gay."

Instead, many participants did not express concerns about the future even as they used their futurity to help weather the present. Some, like Reid quoted above, could not envision a future in STEM where they could be accepted for their whole selves, and started to plan for a different future that was more welcoming of a queer utopia.

Discussion

Analyzing data gathered from over 50 participants in tandem with contemporary queer theory enabled us to explore how these students navigate their queerness in STEM; strategically split their queer and scientific lives to navigate different personal and professional chronologies and spaces; and develop thinly utopian projections of their futures in STEM that are focused on surviving an exclusionary environment, rather than producing radical social visions.

Juxtaposing our participants' experiences with queer theory begs two questions in undertaking this work: (1) Do STEM learning environments constitute homonormalizing environments for students with MIoSG? (2) How does this impact them in the future? The answers rest on neoliberalism's involvement both in STEM fields and the lives of people with MIoSG.

The students interviewed in this study grew up and came out in a sociopolitical environment and moment characterized by neoliberalism, depoliticization of the sciences (Cech, 2013), the erosion of investment in public goods, and the homonormative turn (Duggan, 2002). Once in college, they chose majors deeply entangled in neoliberal discourse as well as whiteness and white supremacy (Carter, 2017; Le and Matias, 2019; McGee, 2016; Slaughter and Rhoades, 2004). The combination of these several developments—neoliberal politics in private and academic life as well as the mainstream gay community's homonormative turn under an umbrella of power, privilege, and oppression fueled by white supremacy—suggests that MIoSG students in STEM may eschew explicitly queer politics in favor of more private, depoliticized sexualities. We found that students both separate their private lives from STEM/academic/professional spaces and view future-time as more suitable to being out in STEM than the present. These findings indicate that postsecondary STEM programs may be normalizing spaces and times that enforce cis-hetero embodiments of sexuality and gender as well as depoliticized perspectives in the sciences structured by normative whiteness.

Looking at STEM as a normative space answers, in part, Oswin's (2008) call to pay less attention to whether a space is queer or straight and more attention to its hetero- and homonormativity. STEM spaces are neither uniform nor specific; in other words, STEM takes place in a variety of public, semipublic, and private spaces, such as classrooms, labs, libraries, living rooms, and bedrooms. STEM space cannot be specifically demarcated, yet its impact can be felt in the public and private lives of the students interviewed in this study. At times, students felt that their lives were at odds with the chrononormativity and chronobiopolitics (Freeman, 2010) represented by neoliberalized STEM majors. At other times, they showed the ways that they were invested in similar homonormative formations of family, work, and capital. At first glance, these students do not seem to fit Halberstam's (2005) conception of queer communities as those with "non-normative logics and organizations of community, sexual identity, embodiment, and activity in space and time" (6). However, although our participants may not have been engaged in traditionally queer cultural production, they were engaged in political production through their persistence in STEM spaces designed to resist their presence. Having MIoSG and being in STEM seem to be at odds, and yet our participants make space and time for their selves to be there, which is simultaneously a radical and normative act. Participants displayed the understanding that bringing their whole selves—their trans, gay, lesbian, pansexual, agender, gray romantic selves—could be the catalyst for change, either in their own lives (through exclusion or acceptance) or the academic STEM spaces they are entering. In other words, people with MIoSG could disrupt the trend of depoliticization in STEM. If they came together as a more cohesive community, there is the possibility that MIoSG students could queer an "un-queer" space and create of queer future possibilities in STEM. However, this potential is unlikely precisely because of participants' entanglement with neoliberalism. In other words, this neoliberal turn in both STEM and mainstream gay politics presents limitations to the development of queer identities for MIoSG students in STEM.

STEM's hetero- and homonormativity impacts the ways that students imagine their futures as people with MIoSG in STEM. Many of the participants expressed desires for fairly normative futures, ones that include families, work, and economic mobility and security. Of course, there is no requirement that a person be queer or invested in queer utopias simply by virtue of their MIoSG. The issue is not that our participants are either queer and radical or mainstream and neoliberal, and plan for the future accordingly. Rather, it is a situation of both/and—participants speak to utopian potentialities (Jones, 2013; Muñoz, 2009) while simultaneously conforming much more to the chrononormativity most closely tied to heteronormative, white, capitalist formations of family and state (Freeman, 2010; Halberstam, 2005). At the end of the day, these MIoSG students are attempting to dream their way to different futures in STEM than the ones that they have been previously offered but find themselves potentially limited by a lack of

alternatives due to STEM's entanglement with neoliberal politics. It is possible that it is STEM and the ways these fields discursively (re)construct themselves, and not students with MIoSG, that contributes to this theoretical dissonance. STEM educators and STEM spaces need to create room not only for people with MIoSG but also for the kind of theoretical imagining and production at which queer theory excels. If we take college as a time and place in which futures are constructed and produced, then it seems that postsecondary STEM spaces only use resources that help students construct futures that are normative and fixed. These thin utopias expressed by our participants cannot be deepened or expanded with a few easy fixes; however, this indicates that some curricular and content changes may be needed in STEM.

Limitations

As with any study, we do have some limitations at work in this article. First, our participants were predominantly white. While the demographic makeup of our participant pool mirrors the demographics of the institutions and geographic locations where the research took place and the quotes used were representative of the full dataset, it also means that this work centers whiteness and the experiences of white people with MIoSG in STEM. This study also juxtaposed theories with radical histories and foundations with profoundly un-radical contexts; there is a limit to queer theory's applicability to participants who do not identify as queer. While we found fruitful provocation and analysis with this juxtaposition, we acknowledge that the difference in goals for our participants and queer theorists is a limitation of this study. Additionally, although we take seriously Muñoz's (2009) queer of color critique of normative conceptualizations of queer futurity, we do not focus as closely on race as a salient dimension as we do in other studies (see Forester et al., in preparation; Vaccaro et al., in press). A key reason for this decision concerns the challenges that many MIoSG students in STEM have discussing race (Forester et al., in preparation) and the resulting flattening of findings related to temporality when examining variations across racial identities.

Implications for research and practice

Theory and research

In our larger grounded theory study, we identified emergent findings related to temporality and decided to explore these findings more closely through the lens of queer theory. In doing so, we drew on theories relating to both queer temporality and queer spatiality, as well as queer utopias. Time plays several roles in both the student experiences captured here and in our study of them. It is not enough to interrogate the present for MIoSG students in STEM; researchers need to be

attuned to considerations about not only the personal past, present, and future, but also the broader chronologies at work. These chronologies include broad historical arcs, regional and discipline-based events, and even institutional histories. Future research should also interrogate the ways that many of the constructs in this article—time, STEM, queerness, and neoliberalism, for example—are racialized concepts that are entangled in white supremacy. This research should not only explore this racialization, but also delve into the ways that these racialized concepts impact queer students of color in STEM. A study designed with this focus from the outset could address the limitations inherent in our dataset by simultaneously helping participants to develop a more complex vocabulary for discussing both queer and racial biopolitics. Furthermore, our findings suggest that, in addition to temporality, futurity needs further exploration in higher education research on STEM environments. Additional work on the way that queer theory confronts both science and neoliberalism would be especially beneficial in higher education research where colleges and universities actively replicate both norms. Additionally, future research should also address the role that peer and faculty interaction plays in MIoSG students' internalization of chronobiopolitics and chrononormativity. This avenue of research could shed light on whether the constriction of political futures in STEM takes place only on a discursive level, or if it also works in more intimate, daily interactions.

Campus-level practice

This study also has implications for campus-level practices and programming. In terms of STEM majors and learning spaces, we found that students seemed to have an impoverished sense of future possibilities. STEM educators should review curricula—for individual courses as well as programs of study—to include space and time for the inclusion of critical theory and humanities. In other words, while MIoSG students find ways to bring their whole selves to STEM spaces, STEM spaces need to expand to embrace radical imaginaries of what futures could be possible. We found that our participants maintained fairly distinct boundaries between their professional and personal lives, with their MIoSG firmly in the personal sphere. While some were active in queer and/or LGBTQ+ student or community organizations, many were not; indeed, many of our participants sought to understand their identities through normative spaces—for example, within their academic disciplines or from internship placements. They also expressed concerns about both time and perception that would make it difficult to make their way to distinctly queer spaces. These findings raise questions about how to reach MIoSG students in the time and space that they inhabit. For example, higher education and student affairs professionals working in areas such as academic advising or career development might find themselves the primary or perhaps even only point of contact for students seeking to understand their MIoSG within STEM disciplines and future careers.

A key takeaway from this research is that campus educators—including faculty, student affairs staff, and academic affairs staff—need to have extended and frank conversations about the presents and futures of MIoSG students in STEM. These discussions need to not only contend with issues like campus climate and support services for students with MIoSG. They need to engage more fully with the sociopolitical realities shaping these students' futures, including effects from geographic locations, institutional histories, and national and global events and trends. Programming should be created to specifically engage STEM students in holistic conversations about the ways their identities impact their relationship with time and space. This could be implemented through cross-campus collaboration, both within student affairs and within academic affairs. Within academic affairs, STEM fields can be intentional about requiring electives centered around the humanities and should look to recruit STEM professors who can engage students in the complexity of the here and now of their identities. Cross divisionally, student affairs professionals can team up with STEM faculty and staff to help create and support oSTEM chapters and to incorporate the importance of utilizing campus resources by STEM students.

In short, practitioners need to engage more with time and temporality—not only the time that students spend on their campuses and in their classes, but also the temporal possibilities presented by different political and cultural movements. In so doing, perhaps educators can join MIoSG students in dreaming new futures and spaces for a queer STEM.

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Note

1. The participants in this study described their gender and sexual identities in many different ways; many participants did not use the term "queer," and some actively rejected that identity. Therefore, when we reference student identities, we either use MIoSG (Vaccaro et al., 2015) or terms they used themselves. However, consistent with this article's use of queer theory, we also use the term "queer" when describing the impact of the STEM participation of people with "nonnormative logics and organizations of community, sexual identity, embodiment, and activity in space and time" (Halberstam, 2005: 6).

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