A THIRD MATHEMATICS IS POSSIBLE

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Abstract. In the interest of theorizing abolitionist and critically conscious approaches to mathematics, we closely read articles by Tian An Wong and Piper Harris, taking note of the ways in which their anti-carceral scholar activism and queer Black feminist care work, respectively, move with and against the standards of academic mathematical writing. We invite the reader to ponder alongside us how and to what extent we can repurpose mathematics, a field so entrenched in anti-Blackness and the prison-industrial complex, toward alternative, liberatory futures—to adapt K. Wayne Wang's words, whether a *third mathematics* is possible [14]. Coupled with an accompanying piece experimenting with the epistemological hierarchies of mathematical research practices, especially in the literature on predictive policing, this paper also serves as a final project for the course *"I Don't Like to Argue": The Styles and Politics of Humility* taught by Dr. Sunny Xiang and Minh Vu at Yale University in the fall of 2024.

1. Introduction

Like many of the sciences, the growth of mathematics as a discipline in the past few centuries dovetails with transnational military and capitalist projects. Conversely, the rigid structures of mathematical argument reify the material forces of eugenics, surveillance, war, and racial capitalism. Mathematicians therefore have a responsibility to disrupt these logics; in this paper and its supplementary experimental piece (`https://luc-ta.github.io/files/predpol.pdf`), we[1] ask what such a critically conscious mathematical practice might look like. To that end, we propose an exploration of more expansive modes of mathematical writing and inquiry that admit more historically and politically nuanced approaches to the discipline.

If the vernacular of the quantitative reifies the interlocking logics and contradictions of militarism, colonialism, and capitalism, how can mathematicians complicate these logics in our work? As the cold, impersonal style of mathematical writing and argument—not to mention the hegemonic frameworks of individualism and competition through which institutions conceive of mathematics and science—embeds into this epistemic hegemony, how can alternative visions of mathematics research disrupt it? What can a field

[1]Mathematical writing is typically set in the first-person plural, even in articles written by a single author. With the exception of the acknowledgements section, we intentionally embrace this convention to honor the collective and composite nature of scholarship in both mathematics and in the humanities. We also adopt this convention as a means of inviting the reader to sit with, ponder, and extend the questions of this paper alongside us.

so often imagined as binary and either-right-or-wrong contribute to investigating the nuanced questions, ambiguities, and contradictions arising from these imperial logics? What can a more communal, critical, or expansive mathematical practice look like? Can repurposing or reframing mathematics toward alternative futures begin at the site of the research paper? Adapting Yang's words [14], is a "third mathematics" possible?

Although none of these questions admit conclusive answers, they fundamentally concern and politically contextualize our work as mathematicians. In this light, this project embraces and inhabits the ambiguities, conflicts, and holes surrounding the racialized histories and politics of mathematics. One part of this project is an experimental piece of mathematical writing that exaggerates and politicizes the epistemological boundaries between mathematics and the humanities and qualitative social sciences. We invite the reader to sit with the resulting questions over these disciplinary conflicts and opportunities for critical mathematical inquiry.

In the majority of this project, we contextualize the aforementioned questions in the racializing and imperial projects of capitalism and the carceral state and begin to theorize an insurgent "mathematics from below." To this end, we closely read research articles by Tian An Wong and Piper Harris, two queer mathematicians of color. We examine the ways in which they inhabit the genre of the mathematics article and integrate leftist critique into their scholarship. We resist the mathematical urge to provide a conclusive generalization, formalization, or tabulation of these mathematicians' stylistic techniques. Instead, we invite the reader to ponder these questions alongside us and embrace critical mathematics scholarship's open-endedness, its expansiveness, its creative capacity to theorize and imagine new possibilities and futures.

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I'm going to save a more comprehensive list of acknowledgements for my two senior theses (ouch) in mathematics and ER&M. That said, this

[2] In mathematics articles, it is customary for acknowledgements sections to come either at the end of the introduction or at the end of the entire article. Rather than adopting the latter convention or siloing the acknowledgements as "front matter," we adopt the former convention as a means of making our acknowledgements (literally) central to the text rather than something to skip over while reading.

paper already lies at the intersections of my two majors and, like my theses, symbolizes the growth and lessons I've learned over my 3.5 years at Yale. So, I want to thank Rasheed Tazudeen, Alicia Schmidt Camacho, Zareena Grewal, Lisa Lowe, Hi'ilei Hobart, Ximena Lopez Carrillo, Daphne Brooks, Brennan McDaniel, Babette Thomas, and all the other scholars in ER&M, English, African American Studies, and American Studies who have given me tremendous amounts of inspiration and support throughout my time at Yale.

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2. On Predictive Policing, Quantified Racialization, and Theorizing an Abolitionist Mathematics

In this section, we turn our attention to mathematics research on policing. In particular, we closely read several articles on the predictive artificial intelligence algorithms that police departments and militaries in the United States and Israel have recently deployed in Black and brown neighborhoods and in Gaza. On the one hand, we read the work of representation theorist[3] and liberation theologian Tian An Wong and their collaborators in [7, 8, 15], noting the ways in which their mathematical analysis dovetails with their critiques of the carceral state. Keeping in mind the abolitionist and Black studies scholarship of Erika C. Bullock and Erica R. Meiners [3] and Katherine McKittrick [10], respectively, we pay attention to the roles and places of the humanities and qualitative social sciences in these analyses and critiques. On the other hand, we contrast these works of mathematical scholar activism with articles like [12] that develop mathematical policing tools, algorithms, and models while eliding any kind of critical reckoning with the politics of this work. Finally, we present an experimental piece that meditates on the racialized discourses and epistemological hierarchies of the mathematical literature on policing algorithms.

A critical mathematics practice must be abolitionist; it must critique the ways in which mathematics currently operates as an arm of the prison-industrial complex (PIC) and imagine alternative, liberatory paradigms for the field and the communities that institutional mathematics racializes and subjectifies. In [3, pp. 340-341, 343], Bullock and Meiners show that institutional mathematics and mathematics education reify an "anti-Black capitalist opportunity structure" closely linked to eugenics and "the foundation of slavery, genocide, and mass incarceration." They argue that dominant mathematical discourses in their current form act as "an agent of the carceral state [...] as a way of ordering the world and reifying social hierarchies. [...] Like prisons, this ordering appears logical and necessary," and those subjectified

[3]Representation theory is a confusingly named branch of abstract algebra. Wong's research does not engage in neoliberal representation politics.

as lacking "mathematical knowledge [...] remain subordinate objects of the world rather than potentially agentic subjects." In particular, this is inherently a *racializing* process; in the words of McKittrick, "the mathematics of the unliving" surveils, tabulates, and criminalizes Black life, subjectifying "Black freedom [...] within an economy of race and violence [...] as an indeterminate possibility" [10, p. 17]. In short, the mathematics of the unliving—the dispossessed, the policed, the dehumanized—extends the logics of capitalism, the carceral state, and systemic anti-Blackness, keeping the PIC on life support.

The current state of mathematics as a carceral discipline leads us to ask how we as critical academics might repurpose the tools and epistemological authority of mathematics toward abolitionist futures; we turn to Wong's scholarship in [7, 8, 15] in search of answers to this question. In particular, Wong and their collaborators Joseph Johnson and Theo McKenzie published [7] in the August 2024 *Notices of the American Mathematical Society*, a famous mathematics publication to whose monthly newsletter very many professional mathematicians are subscribed. Such a far-reaching publication begs for a close reading of how Wong et al. communicate their anti-policing activism to their colleagues in the discipline, many of whom politically disengage or find solace in the lie that their work is apolitical.

The main writing strategy Wong et al. take in [7] is to gradually transition throughout the article from the specific to the general and from mathematical to the human and social-scientific, all the while peppering in critiques to various studies and discourses in the literature that remind the reader of the racialized implications of this line of research. On its own, the introduction would make it seem as if the article stayed in the realm of mathematics without borrowing from the humanities or social sciences. The introduction also gives the impression that the article will focus solely on predictive models of policing, if not solely on the LAPD-funded PredPol algorithm. This prevents those mathematicians who align themeselves with the political status quo from feeling alienated at the start of the article, an effective strategy for the publication's wide-reaching audience. For the first half of the article, these political critiques appear as periodic interjections alerting the reader that the four assumptions made in many mathematical articles on predictive policing assume the very best from police and, in view of McKittrick, erase and subjugate the communities of color they surveil [7, p. 933]. These critiques are incisive in a way we can only describe as "throwing shade": "Crucially, the study retains Assumption 3, namely, that reported and discovered incident rates track the true crime rates, an assumption that is empirically false in general" [7, p. 934].

Wong et al. gradually reveal throughout the article that their critique is not limited to predictive policing; instead, they call upon their colleagues to critique the carceral system at large. To this end, they present their critiques in both mathematicial and qualitative ways. In particular, they present the following theorem two-thirds of the way through the article.

Theorem 1. [9, Theorem 1.1] *Consider any assignment of risk scores across members of a population sorted into bins that satisfies the following three fairness conditions:*

(1) *Within each bin, the groups (e.g., racial groups) individuals are in do not affect the accuracy of their assigned risk score.*
(2) *The assignment of risk scores is not systematically more inaccurate for negative predictions in one group than the other.*
(3) *The assignment of risk scores is not systematically more inaccurate for positive predictions in one group than the other.*

Then the assignment is trivial in that either every prediction is perfect or everyone is assigned the same prediction.

Intuitively, this theorem states makes mathematically rigorous the argument that "any nontrivial assignment of people to individual scores must be, in some sense, unfair" [7, p. 935]. Therefore, *any* method or algorithm to predict or detect "crime" will be biased (and racially so, by the design of the carceral system). Indeed, in the following section of the article, Wong et al. argue in light of non-mathematical literature on the subject that this critique extends not only to predictive and proactive policing but to policing and surveillance in general [7, p. 936]. By prefacing this more radical and general critique of the carceral system with mathematical formulations of this critique in the specific contexts of predictive policing algorithms, Wong et al. provide an introduction to abolitionist thought in a form digestible, unalienating, and sufficiently mathematically rigorous for their audience of general mathematicians. At the very end of the article, the authors address this audience with an invitation to further develop such a critical consciousness of the carcerality of mathematics:

> While the mathematics and scientific communities aspire to maintain neutrality, the reality is that we introduce our own biases through the fundamental assumptions of the models we create. We must be acutely aware of the potential applications of our mathematical innovations. It is not surprising when after mathematical research is handed over to law enforcement, it is then used to further oppress those already victimized by police violence. [...] We hope that this examination of predictive policing prompts a reflection on the projects that the mathematical and scientific broadly opt to pursue. [7, p. 936]

This invitation is sorely needed, as many articles in the literature lack any kind of critical component to them. For example, in a seminal paper developing the models used in the PredPol algorithm [12], there is no mention of *any possibility* for racialized biases in the algorithm's design or implementation in police departments. Instead, the article reduces the humanity of the surveilled in the gloss "crime hotspots" [12, p. 939]. Unsurprisingly, Andrea Bertozzi, one of the mathematicians who authored this article, invested in PredPol, Inc. Moreover, her "response" to critiques of her work was simply to say, "I think these are good discussions for people to have," and profess her desire not to "generate division in the math community right now" [4]. In light of these comments, which completely miss the point and do not discuss the problem at hand at all, the work of Wong et al. in raising a critical consciousness in their colleagues so carefully and within the format of mathematics research is both effective and highly necessary.

Wong's scholar activism inspired the other part of this work, an experimental piece available at `https://luc-ta.github.io/files/predpol.pdf` that questions the political effects of not only the development of mathematical policing but also the carceral logics embedded within the research itself. To be clear, we do not intend for this piece to model what a more liberatory or anti-hierarchical mathematical writing style can look like; we leave this as an exercise for the reader.[4] In fact, the piece's stark division of content between body and footnotes *leans into* the epistemological hierarchies of the discipline—pure mathematics in the body, with all else sidelined to the margins—to ask *whom* current mathematical research practices marginalize and how we as insurgent scholars might resist this racializing paradigm.

3. From the Mathematics of the Unliving to a Mathematics From Below

In this section, we closely read sections of the fairly well-known dissertation of number theorist and queer Black feminist Piper Harris [6]. To the objection of their editors, Harris composed their dissertation they intentionally wrote in an accessible style and a personal voice. This leads us to ask how and to what extent Harris's dissertation, despite its abstract, number-theoretic subject matter, acts as queer Black feminist scholarship. In our close reading, we keep in mind Jack Halberstam's treatment of failure as a method of queering hegemonic modes of knowledge production [5], McKittrick's theorization of Black methodologies in academic research [11], and Jennifer C. Nash's analyses of Black feminist writing [13]. These questions guide our comparisons of Harris's thesis with a subsequent edition condensed for publication in a journal [2]. Between this edition's tightly packed mathematical arguments, where might we find the holes that Harris's Black feminist mathematical work fills in?

While Harris's research lies in pure rather than applied mathematics, making its connection to politics less immediately obvious, Harris makes it clear from the very beginning of their dissertation that their work is political. The very first sentence of Harris's thesis links institutional mathematics to patriarchy and describes the (racialized and gendered) ways in which their communities, who "don't do math the 'right way'," are systemically excluded from the field (cf. [3]). This motivates the accessible fashion and authentic voice by which they present their mathematical results:

> Respected research math is dominated by men of a certain attitude. Even allowing for individual variation, there is still a tendency towards an oppressive atmosphere, which is carefully maintained and even championed by those who find it conducive to success. [...] Second thought: but what about the others like me, who don't do math the "right way" but could still greatly contribute to the community? [...] My thesis is, in many ways, not very serious, sometimes sarcastic, brutally honest, and very me. It is my art. It is myself. It is also as mathematically complete as I could honestly make it. I'm unwilling to pretend that all manner of ways of thinking are equally encouraged, or that there aren't

[4]This is a common turn of phrase in mathematical writing. We adopt it here with the intention of inviting you to ponder this alongside us.

> very real issues of lack of diversity. It is not my place to make the system comfortable with itself. This may be challenging for happy mathematicians to read through; my only hope is that the challenge is accepted. [6, p. 1].

Indeed, Harris prefaces pages filled with mathematical jargon, definitions, theorems, and calculations with expositions of the background material written at a conceptual, introductory level. This makes Harris's extremely involved applications of abstract algebra, Galois theory, and measure theory feel less intimidating to read, and many of Harris's explanations of the concepts at play express their own difficulties with learning and researching the subject: "First thing to learn is the 'Pfaffian.' I don't know what kind of life you have to lead to have heard of a Pfaffian, but I had to look it up on Wikipedia" [6, p. 48].

This work of not assuming any formal mathematical background from the reader, disclosing one's struggles in navigating mathematics, and writing in a way that helps guide and relates to the reader is a form of affective care work. It extends what Nash describes as "a longer Black feminist tradition that has centered survival, wellness, care, friendship, and intimacy as strategies of safeguarding Black women's bodies and fundamental humanity" [13, p. 13] to the field of mathematics. This is an extremely subversive tactic in a field that so often reduces Black women to "subordinate objects of the world rather than potentially agentic subjects" on the one hand [3, p. 341] and sets of tabulations or statistics that foreclose Black life on the other hand [10, p. 18]. In this light, Harris's acts of meeting the reader at the reader's level rather than expecting the reader to meet Harris at their Princeton Ph.D.-in-mathematics level builds solidarity, challenges "objectivity and neutrality" of mathematics and other theoretical fields within the university, and claims a space for Black life and affect in a field that invisibilizes it: "Black feminism is, at least in part, a project about feelings—making feelings visible; making clear how feelings are racialized and gendered; thinking about how to feel differently, how to feel better, how to feel anew, how to feel collectively" [13, pp. 15-16].

In stark contrast to the first line of Harris's dissertation, the 12-page version condensed for publication in a mathematical journal opens with, "Let K be a number field of degree n and $\mathcal{O}_K$ its ring of integers" [2, p. 1]. Indeed, the condensed version does not contain a single trace of Harris's voice or expressly subversive mathematical mission, save for a mention of their husband in the acknowledgments section. Indeed, an editor's note in Harris's dissertation suggests that the inclusion of Harris's anecdotes about struggling in mathematics may damage their perceived academic credibility, especially in light of the scrutiny that Black women mathematicians already face in their careers:

> Editor's note: The author throws in many phrases that seem to indicate uncertainty; please know that this does not represent *mathematical* uncertainty, but is meant to relay the following to student readers: 1) you are not expected to understand every word as you read it, 2) you can successfully use math before you've successfully understood it, and 3) it has to be okay to be honest about your understanding. The author refused to sacrifice these messages or

> what she called her "integrity" for the sake of what we saw as very important mathematical credibility. [6, pp. 12-13]

Indeed, even though mathematics research is not done at all linearly (as any mathematician knows), it is customary in the field to present the research in a linear fashion in articles and textbooks, as if the researcher had figured it all out without encountering any obstacles along the way. Harris includes the obstacles they encountered throughout the paper with the explicit intention of showing readers, especially those racially excluded from mathematical discourses, that any struggles they may encounter with mathematics do not disqualify them from the field: "I spent years trying to fake puppeteer lingo, but I have officially given up. My goal here is to write something that I can understand and remember and talk about with my non-puppeteer friends and family, which will allow me to speak my own language to the puppeteers" [6, p. 3].

As the above editor's note makes clear, the vulnerability with which Harris narrates their mathematical process disrupts the racialized and gendered linear standards of mathematics within the university, firmly placing vulnerability among other Black research methodologies that, in McKittrick's words, "subvert the academic form (that confident authoritarian form with accompanying concrete answers)" [11, p. 4]. In light of Halberstam's work in [5], we might also read Harris's openness with their mathematical struggles as a queer methodology. Diverging from mathematical writing conventions, Harris frequently abandons the first-person-plural to alternate between the second-person and the first-person-singular to discuss what they "find [...] confusing" in their research and how they actually conceive of it:

> Pretend, if you will, that we only have ten points to count: $v_1, v_2, \ldots, v_{10}$. One way to do this, of course, is to line them up and count. Each v_i is the ith in your count. If only it were so simple for what we want to do! [...] That's just the organizational stuff, though. I spend a lot of time there because I find it confusing and hard to keep track of. The important part is what happens next, though, because even after we're organized, we're not actually going to have something we can just count. [6, p. 54]

In this way, Harris's writing embodies Halberstam's call for academics to "resist mastery" and exhort the subversive intellectual to [...] refuse professionalization, forge a collectivity, [...] investing in counterintuitive modes of knowing such as failure and stupidity" [5, p. 11]. In Halberstam's view, the loss of "mathematical credibility" forewarned in the aforementioned editor's note is subversive, for "the goal is to lose one's way, and indeed to be prepared to lose more than one's way" [5, p. 6] in what he might call a *mathematics from below* [5, p. 11]. Even as this loss of credibility is intimately tied to misogynoir in Harris's case, Harris nevertheless embraces Halberstam's goal and, in doing so, disrupts the racialized and gendered standards of academic rigor in institutional mathematics. They model what Black feminist care work can look like in mathematical writing and, in doing so, call attention to the ways in which whiteness and patriarchy embed

into institutional mathematics through discourses of credibility, rigor, and authority.[5]

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[14] la paperson, *A third university is possible*, University of Minnesota Press, Minneapolis, 2017.

[15] Tian An Wong, *The mathematics of policing*, 2022.

[5] It is customary for mathematics articles to end abruptly, that is, without any kind of "Conclusion" section. In some settings, especially in the literature on policing algorithms, this may allow authors to sidestep discussions or critiques of the wider political implications of their work. Nevertheless, we adopt the practice here in the spirit of Crystal Mun-Hye Baik in [1, p. 185], who offers, "[i]n place of a more traditional conclusion that encompasses a comprehensive compilation of the book's key findings," an "essay in-progress." Our work as scholars imagining alternative futures and critical and anti-carceral approaches to mathematics (and other fields) is, too, a work-in-progress. We hope that the space this abrupt ending provides empowers you to imagine these possibilities alongside us.