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Talking the Talk:" Mathematical Language, Linguistic Bias, and The Delusion of Meritocracy in the Study and Practice of Mathematics

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“Talking the Talk:” Mathematical Language, Linguistic Bias, and The Delusion of Meritocracy in the Study and Practice of Mathematics

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Abstract

Challenging the dominant narrative of meritocracy, objectivity and moral/ideological neutrality embraced by many mathematicians, this thesis critically interrogates the form and function of mathematical language within academic and professional mathematical spaces. Grounded in my own experience as a student within the discipline and the frameworks of various scholars within the subdiscipline of literacy education, I offer an understanding of the language of these spaces as a veritable form of literacy implicated in a flexible sociocultural context and dependent on one's access to forms of capital. I submit that this language serves various functions including, but not limited to: the paternalistic and elitist conflation of mathematical ability with the ability to deploy mathematical terminology; the regulation, marginalization, and/or exclusion of aspiring mathematicians from culturally and linguistically diverse backgrounds; and the encoding of implicit bias masked behind discussions of standardization and appropriateness. After exploring the implications and consequences of the uncritical reliance on this language, I conclude with a series of potential action steps that may be taken by educators in the pursuit of a discipline that works for the good of all mathematicians, rather than a select few.

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Introduction

It was the first day of classes during my freshman Spring and, taking a seat in my Honors Several Variable Calculus course, I could barely contain my excitement. Of course, part of the allure was that one of my very good friends and I had signed up to take the course together, and I made sure to grab the seat next to her as the one thing I could rely on to ground me in an otherwise unfamiliar setting. But, in reality, it wasn't the new classroom, or the sea of new, unfamiliar faces, or even the promise of the new semester I was most looking forward to: it was this math class in particular.

For one, I had just entered the second semester of my freshman year, the first without the safety net of Pass/Fail granted to all first-semester students. It certainly helped that I was riding the high of having performed much better than I had expected to in my Linear Algebra class in the Fall. As I was planning to pursue a degree in Mathematics, and knew from conversations with upperclassmen and faculty that the department preferred that students interested in a potential major enrolled in the Honors section of a given course whenever the opportunity presented itself, I sent an email on a whim to the professor now standing in front of me at the blackboard, chalk in hand. Although admission to the class was typically reserved for those who had been placed by the department into the Honors section of Linear Algebra, I made a case for my enrollment, citing my performance the previous semester and my prior knowledge of multivariable calculus from the couple of months I had spent studying it in high school. I was surprised to find a response in my inbox a few days later, and even more so to find that my request had actually been granted.

Everything seemed to be working out in my favor. I had heard amazing things about the professor, who was held in high regard by faculty and students alike, and it goes without saying

that I was thrilled by the prospect of studying with someone so widely praised. I was fascinated by the material, and was eager to do a deeper dive into something that I had already been exposed to in some detail. But even so, beyond anything else, I felt that I had a lot to prove. I was the only person taking the class who had not come from Honors Linear Algebra, a position that I had staked on thus unfounded claims of sufficient experience and of my own commitment and intellectual capacity. For all intents and purposes, whether I liked it or not, the odds of my success were stacked against me. If I faltered, it would be no one's fault but my own. But I had exceeded my own expectations once already, and I was excited by the challenge to do so again.

By the end of day one, however, I realized that I had made a mistake. By the close of that first week alone I was overwhelmed, but because the material still seemed somewhat familiar, and I felt that my reputation depended on my ability to outlast and outperform my classmates, I held onto the hope that things would improve. Even as I continued to struggle just to keep my head above water, I remained, as other students — all of whom had actually placed into Honors — dropped into one of the sections of standard Several Variable, and some out of the department entirely. Along with a number of other students who chose to stay, I shrunk myself to the back of the room as a clique of students composed primarily of cisgender, heterosexual white boys, who aced every assessment and infallibly predicted the professor's movements at every turn, formed in the front. With time, as they grew more comfortable with the professor and had already won respect by demonstrating their mastery over the material, they took advantage of the opportunity to ask questions and offer alternatives that, at least to those of us in the back of the room, had little to no bearing on what we were actually being asked to study. Invariably the professor's interest was piqued and, excited by their wealth of prior knowledge, would smile and indulge them. While I don't think that the professor was intentionally trying to leave any of us out of

those discussions, entire sessions were derailed as large swaths of class time became devoted to tangential lectures which were not easily connected to course material at best, and entirely unrelated at worst.

The problem worsened over the course of the semester, especially as the majority of the information I had retained from the previous year had been covered by week four or five. I was invested in learning the new concepts, and yet the words that both my professor and my classmates used to describe them sounded so intelligent, but somehow so meaningless at the same time. I found it increasingly difficult to figure out where the material I was actually expected to understand stopped, and the supplementary material started. But objecting to their contributions or the lines of inquiry they explored was out of the question. I knew I couldn't compare to or compete with my classmates, and felt embarrassed that I was asking for constant clarification on topics they already understood. I attended problem sessions and office hours, but Impostor Syndrome had already set in. I apologized profusely for my incompetence, my lack of comprehension, my inability to clearly express my ideas using the kind of mathematical terminology that everyone around me already seemed intimately familiar with. With each coming week, my mental health reached new lows, and the image of myself as a mathematician that I had entered Swarthmore with grew increasingly distant. I barely managed to keep on top of my schedule, losing sleep and breaking down into panic attacks on more than one occasion as it grew harder and harder to complete my problem sets, feeling completely unequipped to do so on my own. Not wanting to be a burden or a nuisance by asking for help and holding on to the last remaining threads of confidence I had in my abilities as a math student, I put my head down, gritted my teeth, and, knowing that I couldn't exhaust a Credit/No Credit designation on a course

required for my major, just hoped that I would pass. Somehow, I did; to this day, it is still the worst course grade that I have ever received.

As I entered sophomore year, I was optimistic that my experience in Honors Multivariable was the exception rather than the rule. Quickly, however, I realized that it was Linear Algebra that had in fact been the outlier. I enthusiastically enrolled in Number Theory — a course for which I had met all the prerequisites — where I was promptly told by my professor during the first week of classes that I should consider an alternative course, given the discrepancy between the absurdly high threshold of prior knowledge that the other members of the class possessed, and my own. Against that advice, and perhaps against my better interest as well, I remained in the class, as someone with something to prove to both my professor and to myself. Even with material that felt like it should have been largely intuitive, I couldn't shake the feeling that I was a fish out of water and, especially when working in pairs or groups with other classmates, the weakest student in the room. The following semester, I took the advanced version of Differential Equations, where I was reunited with many familiar faces from my Several Variable course; there I encountered the same problem as the year prior, but to an even greater degree. Our professor, although clearly excited about teaching the course and always approachable, was exceedingly susceptible to distraction by mathematically literate "math bros," who took extreme pride in their vocabulary and, while they'd never admit it outright, flaunted it as a marker of their intellectual superiority over the vast majority of the class.

In all three cases, it was the use of this language, I realized, that put me at a disadvantage and made the material so wildly inaccessible. On paper, the language itself is not all bad: standardized language serves as a common reference point for experts and novices alike, and for all intents and purposes offers a means for clear, effective communication. And yet, even coming

from a fairly privileged academic background, I simply did not have the tools to discuss and conceptualize mathematics like my peers or professors did, and no opportunities were presented for me to acquire the facility with the mathematical language which professors seemed so keen to reward and to deploy themselves. As a result, sitting through math classes became a chore rather than the joy it had once been for me. With each passing semester my love for mathematics seemed to cave to my mounting disappointment and demoralization and, at the same time, my irritation with students and professors who, to be blunt, spoke simply because they enjoyed listening to themselves speak. It was this frustration with math pedagogy, and the awareness of my rapidly tanking mental health, that played a massive part in my decision to eventually drop my Mathematics major in favor of a special major in Mathematics and Education Studies, where the number of math courses I was required to take — and thus the number of semesters of unnecessarily complex terminology I'd have to trudge through — decreased from ten to seven.

In recounting my own trials with college-level mathematics, I do not intend for this to necessarily read as an indictment of my professors or the Mathematics department at Swarthmore more broadly. Many students continue to find success and take pleasure in their time within the department, and for many of those students, encounters with difficult or challenging material are nothing more than a necessary and expected part of their continued study. My experiences are my own, and I certainly do not wish for them to be interpreted as a comprehensive or overarchingly negative painting of the trajectory of a Swarthmore Mathematics student.

I also feel that it is important here to acknowledge my own positionality; even as someone who is queer, gender non-conforming, and multiethnic, that I present as a white man and have been lucky enough to receive a fairly high-quality education affords me a degree of

proximity to a number of dominant social identities and, by proxy, a great deal of privilege. That is not to invalidate my own feelings; in fact, I am convinced that an awareness of my own marginalized identities — that even if I wanted to, I would never truly be able to approximate the comfortable social location of those "math bros" — had a hand in the potency with which I felt them. Rather, that for this to have been my experience, those undeniably at the intersection of various minoritized identities have almost certainly found it far more difficult, and have grappled with this sense of isolation and discouragement far more poignantly than I ever will.

Perhaps it comes as no surprise, then, that in informal conversations that I've had with other students, who have similarly encountered seemingly impassable levels of difficulty in upper-level mathematics courses — many of whom belong to one or more marginalized identity groups — I know that this sentiment, and the intimate awareness of the language deployed in these spaces as one of the primary obstacles to one's continued success, is not uniquely my own. It is not lost on me that among those of us who regularly found ourselves towards the back of the room in that Several Variable class, desperate to make something of the terminology we were presented with, almost all were non-male, queer, and/or students of color. And Swarthmore is certainly not the only place where students can or do feel this way, or where similar trends may be noted; there seems to be an underlying impression that admission into advanced mathematics spaces in the United States especially is reserved for white, straight, cisgender, financially well-off men (Martin, 2009). That notion, while logically false, often appears to be confirmed by the demographic composition of mathematics or other STEM-focused spaces and research which confirms that Black and Brown students remove themselves from such spaces at significantly higher rates than their white classmates as their courses of study inevitably lead to enrollment in higher-level classes (Bauer-Wolf, 2019).

My experience speaks to a larger trend within upper-level mathematics, whether at academic institutions or otherwise, where the use of mathematical language is an extraordinarily powerful if not necessary tool for success and credibility within the discipline. Mathematicians, many of whom are academics, often revel in their ability to effectively speak in this way as an immediately intelligible sign of their mastery and wear it as a badge of honor. Again, while this in itself is not inherently negative, in academic spaces where such mathematicians reign supreme this has the tendency to create benefits for those with demonstrable mathematical literacy as a product of their access to forms of social, cultural, and/or economic capital. This perhaps unintentional bias further disadvantages students from historically disempowered backgrounds without the same opportunities to develop this proficiency. This can even be, and often is, the case for students from such backgrounds who have demonstrated past success in mathematics, who, even when prepared effectively for specialized mathematics courses, are met with enormous difficulty when asked to adapt to a new code of unnecessarily abstracted and inaccessible linguistic standards.

In the mathematics classroom, I suggest that the ability to "talk the talk" is effectively equated with one's ability to "walk" the mathematical "walk," if you will. In all too many cases, when mathematics instructors are not careful, the study of mathematics thus becomes less and less about actually teaching material to students as it devolves into an exclusive and exclusionary conversation between professors, who at worst may take advantage of the opportunity to hear themselves talk and to flaunt their breadth of knowledge, and mathematically literate students, who are rewarded and favored by professors for their facility with mathematical terminology (Ardila-Mantilla, 2016; Su, 2017). All the while, other students — many of whom may fundamentally understand the mathematical concepts or principles themselves, but lack the

vocabulary to communicate in the language of the mathematical literati — are left to fight an uphill battle as they sift through an absurd amount of, at best, tangentially related material that may well be introduced only to satisfy a professor's or student's ego. While it should be noted that this is not always intentional, it is incredibly pervasive and, I argue, enabled by the structure of the field. And like the mathematics it is used to discuss, the ethical implications of the over-reliance on mathematical language within the discipline are often ignored.

In this paper, motivated by my own experience as validated by the anecdotal similarities of peers and research literature in the field of educational studies, I propose that the language of the mathematics classroom, what I interchangeably refer to as *mathematical language* or *mathematical literacy*, may be understood as a form of literacy in its own right, here unique to mathematics classrooms and to post-academic professional mathematics spaces. Drawing on scholarship within the study of literacy education, I aim to interrogate modes of speaking within these academic and professional spaces and, in so doing, to explore and make sense of the various implications of the unquestioned use of specialized terminology on the discipline at large, and on the students who wish to make their home in it more specifically. Namely, while mathematical literacy allows for clearer dissemination and sharing of knowledge among members of the community by minimizing the potential for miscommunication, by adopting the framework of literacy education I hope to illuminate the ways in which outsized reliance on such language creates hierarchies of mathematical contributions, which:

a) equate mathematical prowess with the ability to effectively deploy mathematical terminology, and thereby the quality of mathematical contributions with the quality of the form in which they are expressed;

b) serve as, and establish, gatekeeping mechanisms that maintain a field composition that over-represents upper-class, straight, white, cisgender men, producing a narrow and often elitist perspective which governs the kind of research conducted by scholars in the field and the kinds of opportunities available to those who are not identified with those dominant identities;
c) benefit, and engender a sense of intellectual superiority among, those with privilege or capital while implicitly disfavoring and creating a toxic environment for those from historically disenfranchised backgrounds;
d) allow mathematicians to hide their biases behind the veneer of objectivity which the discussion of linguistic standardization provides, masking the systematic dismissal of the voices of large swaths of mathematicians from the narrative and creating a pernicious feedback loop which only further isolates them; and
e) ultimately facilitate the move in mathematics away from its applications and its connections to society, as the language it deploys becomes decreasingly "human."

Once again, I imagine this thesis as an opportunity to apply existing literature within the field to problematize the continued, mandated, uncritical dependence on mathematical literacy, in the hope of offering suggestions for potential forward movement. I begin by laying out research literature in the field of mathematics to develop a cohesive picture of the development of mathematical language from both a historical and practical perspective, and also offer statistics on the issue of race and representation within the discipline which not only substantiate my argument, but also provide a clearer look at the current state of mathematics with regards to its demographics. From there, I proceed into my theoretical and conceptual framework, in which I

discuss the work of sociologist Pierre Bourdieu, theories proposed by scholars of literacy education, and the tenets of multicultural education as analytic tools through which to view and qualify my own experience in mathematics education. Following this, I launch into a literature review and a critical discussion thereof, using this space to explore in greater detail and further substantiate the multi-part problem I have posed above and to challenge the notions of objectivity, neutrality, and meritocracy which have become associated with the study and practice of mathematics. And finally, I conclude by drawing upon the literature which has both served as a frame and been the object of my analysis in order to lay out a series of possible action steps that may be taken by mathematics educators, in the pursuit of a discipline that truly works for the good of all aspiring mathematicians, rather than a select few.

The Development and Practice of Mathematical Language

Though its existence as the lingua franca of the discipline is widely acknowledged, in my own research I have stumbled across little to no prominent scholarly work that seeks to actively chronicle the history of the language of mathematics in particular, let alone its development. Nonetheless, that it is recognized as a language implicates communication among contemporaries, but also among generations as its ultimate goal. Whether one looks to the earliest documented mathematical writings of Mesopotamia, the introduction of mathematical rigor and the formal proof by the ancient Greeks and Egyptians, or the foundationally significant collection of works by Issac Newton millenia later, the fundamental role of language in the pursuit of clear expression cannot be overstated (Folkerts et. al., 1999; Cajori, 2011). Its importance as a means of communicating mathematical innovations and the passing on of mathematical thought only increased as the type of mathematics that it recorded became more

advanced, and as more efficient means of circulating mathematical texts through technological advancement became more readily available.

While its history may not be quite as well documented, the nature of mathematical language is widely understood. Among its distinctive features are “a specialist mathematical vocabulary” composed of both discipline-specific terminology, or words invented to communicate uniquely mathematical phenomena, and specialized use of everyday words not unique to the discipline; “specialist syntax,” a kind of mathematical grammar which structures and formalizes meaning; the use of mathematical symbols such as variables, operations, and so on; “specialised ways of talking, including written and spoken forms of mathematical explanation, proof or definition [...] important in expressions mathematical ideas and reasoning;” and a “social dimension” which governs the system of relationships and modes of communication between students and their instructors (Barwell, pp. 2–3). In mathematics classrooms today, where each of these dimensions of mathematical literacy plays out in its own right, there appears to be an implicit understanding that facility with navigating and employing this language is all but necessary.

While purely speculative, it is likely that the move towards abstraction beginning in the 1800’s and the subsequent desire for standardization, as mathematics reevaluated its foundations in light of the fear that modern innovations were built on compromised principles, had a significant impact on this development (Folkerts et. al., 1999). While mathematics had long been understood to be a distinctly human process, innately connected to observations made in and about the real world through the study of physics or astronomy, for example, its recent evolution — most prominently beginning in the nineteenth century, which sparked the desire for greater rigor — has been characterized by a noted preference for pure, speculative, and thus heavily

abstracted thinking among mathematicians. By the following century this progressed into a discussion of logic, where mathematicians hoped to stretch the limits of mathematical comprehension as their efforts became more predictive and future-oriented than responsive to the society they found themselves in.

While its applications were "crude," the act of conducting mathematics as an exercise in itself was purely intellectual. Its allure lay "not in its practical consequences [...] but in the *significance* of the mathematical ideas which it connects," somehow becoming through the process of abstraction, and thus of dehumanization, more "beautiful" (Hardy, 1940, p. 16). The language in which such patterns and observations were discussed became a key component of such beauty, if not outright equated with it.

Racial and Gender Disparities in STEM

Whether intentionally or otherwise, the structure of power and authority in the discipline of mathematics closely resembles that present in larger societal institutions, and among the sciences more broadly. Although Federico Ardila-Mantilla (2016) clearly states in his essay in the *Notices of the American Mathematical Society* (AMS) that "[m]athematical talent is distributed equally among different groups, irrespective of geographic, demographic, and economic boundaries" (p. 1164), within the same essay he observes the prevalence of statistics which document the underrepresentation of individuals belonging to marginalized identity groups, seemingly contradicting this axiom. Among the figures he provides are the rates of demographic representation of those who self-identify as women, Latinx, and Black, respectively, in the broader mathematical community prior to speciaization (50.8 percent, 17.4 percent, and 13.2 percent), in the awarding of PhDs (31 percent, 3.5 percent, and 2.5 percent),

and among full-time mathematics faculty (18 percent, 3 percent, and 1 percent). The implications, as Ardila-Mantilla notes, can be unintentionally disastrous: "[t]hese numbers naturally lead to further underrepresentation in positions of leadership and decision-making power, slowing down the changes necessary to reverse this trend" (p. 1168).

The disparity in representation is only exacerbated the more advanced and academized the discipline becomes. A quick Google search reveals that the majority of those who hold positions of executive power within institutions such as the American Mathematical Society are white men, often with some degree of economic privilege or generational wealth. The trend is reflected in representation among educators; at Swarthmore, for example, of the twenty-one current members of the Mathematics faculty at the time of writing this paper, only five are visibly non-white, while more than fifty percent are men. Even at the level of undergraduate mathematics, as the data presented by Ardila-Mantilla, Bauer-Wolf, and Martin suggest, the prevalence of non-white, non-male, queer, and/or socioeconomically disadvantaged students in mathematics departments across the country is notably smaller than those at the intersection of dominant identities, especially among higher-level mathematics courses. I can certainly confirm this from my own experience, as well; with each successive class in the sequence of courses I followed, I observed as the proportion of those same "math bros" in relation to students of color, female, non-binary, or genderqueer students, LGBTQ+ students, or those who did not come from the same positions of financial privilege trended upwards. While their, and my own, experiences may not have been quite so actively antagonistic as some laid out by Ardila-Mantilla and Martin in recounting their own as educators or those of their students, it is clear that the broader issue of race and representation present in Mathematics and other STEM fields is similarly reproduced, even at an institution such as Swarthmore.

Theoretical and Conceptual Framework

In this section, I lay out prominent theories, frames, and areas of research or inquiry within the field of educational studies, and the subfield of literacy education in particular, that pertain to and reinforce my perspective of the form, function, and purpose of the use of mathematical language in the academy. In order to challenge the impression of meritocracy and moral and ideological neutrality that typically infiltrates the overwhelming majority of mathematical spaces with regards to its work, and thus extends to the language deployed within those spaces in order to muse on that work, I begin by presenting the sociological framework of Pierre Bourdieu and exploring its connections to "radical" schooling theory. I then turn to several prominent scholars and premises within the field of literacy education that will serve to further ground my discussion.

Pierre Bourdieu is, without debate, one of the preeminent voices in the modern discipline of sociology. A prolific philosopher and sociologist, Bourdieu was born in France in 1930. After studying philosophy among the intellectual elites in Paris, he returned to France after a brief stint in the Algerian military, where he developed a noted compassion for those in positions of socioeconomic marginalization and an interest in the systems of higher education. It was there, in Algeria, that he originated and developed the bulk of his sociological groundwork (Kramsch, 2008). As higher education served as the primary source of inspiration for much of Bourdieu's work in developing these theories, it serves us well as a primary framework through which to consider the power dynamics of a mathematics classroom, for example, the subliminal messages encoded in the reliance of mathematicians on specific codes of language, or the problem of representation within mathematics as an academic discipline.

Among the terminology most iconic in Bourdieu's work, and that will be referred to extensively in the body of this thesis, are the concepts of "habitus," "field," "capital," "distinction," and "symbolic violence." *Habitus* may be understood as a set of habits or socialized preferences innate within any individual to behave in a particular way, internalized as a product of their environments; to borrow Claire Kramsch's (2008) words, habitus is "a set of durable dispositions or tendencies to think and act in certain ways, that is inculcated and structured by [one's] family and the school, and enable[s] [one] to become integrated into [...] society" (p. 38). Those from similar social locations, whether geographically or otherwise, often adopt a similar habitus, which translates as their "'natural self' [...] the natural, universal way of being" (p. 39). In the mathematics classroom, for example, one's habitus may include an affinity for or against the speaking of mathematical language, (dis)favorable opinions of particular mathematical exercises, or even the belief or lack thereof in the objective meritocracy of the practice of mathematics.

Such dispositions often play out within, and in reciprocal conversation with, a *field*, "a relational, multidimensional space of activity where agents take up and occupy positions [...] according to how much capital they have" (p. 39); it is "immersed in the larger field of power" (p. 39) that those with the most thereof lead such fields to become sites of conflicting forces and ideals which ultimately reproduce their values. The mathematics classroom, whether that of an introductory Calculus course or of an Honors Modern Algebra seminar, the set of power dynamics among faculty members in an academic department, or the structure of authority of mathematical societies such as the AMS, the Association for Women in Mathematics (AWM), or the Society for Industrial and Applied Mathematicians (SIAM) are all prime examples of fields.

The degree of one's power depends on *capital*, one's ability to leverage their access to economic or symbolic resources including, but not limited to, class attitudes, interpersonal relationships, or specialized knowledge in order to advantage or otherwise positively influence their own future opportunities, or perhaps even to disadvantage the prospects of others. (p. 40). Bourdieu (2016) elaborates that there are several distinct, but necessarily intertwined, forms of capital which one may attain over the course of their lifetime, challenging the popular assumption that capital may refer solely to one's economic means. Among those which he names in particular are *cultural capital*, which may include one's dispositions (as a product of one's habitus), familiarity with particular cultural artifacts, or access to particular ways of knowing, speaking, thinking, and doing; *social capital*, "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition [...] which provides each of its members with the backing of the collectivity-owned [...] 'credential' which entitles them to credit" (p. 88); and *economic capital*, at the root of all other derivations of capital, which accounts for one's financial means or assets and the associated privileges that their possession affords, and serves as the basis for the conversion of other forms of capital into currency. A positive relationship with one's classmates or professor, a history of attending well-funded schools with historically rigorous mathematics curricula, prior mathematical knowledge, and facility with mathematical literacy are all valuable forms of capital.

Distinction describes the social and institutional legitimation of one's symbolic capital within one or many fields. This often takes the form of symbolic rewards, such as the awarding of a good grade to recognize one's academic performance, the attainment of an academic degree to commemorate one's completion of a particular track of study, or the conferring of a title or

honorific that often accompanies a degree, an award, or a promotion to a specific position (Kramsch, 2008, p. 41). Certainly distinction may also include, in the context of mathematics in particular, the admission of a publication or study into an academic journal, the naming of a theory or postulate after a mathematician whose work contributed to its development or proof, or appointment to a leadership position within one of the above mathematical societies or associations. But in many educational spaces, distinction, the author notes, is closely connected "to speaking the legitimate language and possessing the right academic knowledge required by the institution" (p. 41). Kramsch also devotes some discussion to the *profit of distinction*, "the result of a struggle to be noticed, validated, respected, [and/or] admired" which may, for example, "be gained by adopting ways of speaking [associated] with the educated segments of society, that is, that display your membership in the bourgeois class" (p. 41). Some may choose instead to achieve this by leveraging a *strategy of condescension*, by which those in positions of relative power perform solidarity with those with comparatively less thereof by embracing their linguistic codes.

Finally, perhaps most importantly is *symbolic violence*, "the symbolic power exercised by those who possess symbolic resources over those who do not" (p. 42). The awareness and application of such power slowly subjugates those whom it is wielded over, eventually distorting their perspective of educational spaces to the point that they believe their psychological distress to be expected and natural, and in so doing, that they become an accessory in their own oppression. In my own experience, I have felt this symbolic violence intimately in the way that mathematical language is used as a tool to exclude students rather than to invite them in and the favoritism shown by certain professors for students who demonstrate their proficiency with this literacy. Without question, this violence is similarly present in the perpetuation of mythological

narratives, even through innocent jokes, that Black and Brown students and women have the odds of success stacked against them, while white and Asian students and men are inherently predisposed to success in mathematics (Martin, 2009).

Bourdieu is one of the foremost scholars named in "radical" theories of schooling (Anyon, 2005, 2011). Ann Arnett Ferguson (1980) discusses that those who adopt a radical approach to the process of education assert that educational institutions are designed around, and in order to reproduce, the interests of dominant social groups and the existing social, political, and economic inequalities which facilitate their dominance in modern society. To accomplish this goal, schools often rely on what Jean Anyon (1980) dubs the *hidden curriculum*, a set of expectations, implicit lessons, or pedagogical practices which reproduces codes of speaking, writing, and meaning-making practiced by the dominant class; this curriculum simultaneously exacerbates the marginalization of those from lower-class backgrounds by subconsciously instructing them in the tools necessary to occupy predetermined social locations of lower status (Lareau, 2016). Through the symbolic violence which is exercised in dependence on particular narratives, symbols, standards, and strategies, the tastes and values of social elites are enforced and reified as superior to those of the working and lower classes, and ingrained within the academic institution — and society at large — in the same breath. In mathematics classrooms across the nation, this takes the form of the belief that traditional mathematical literacy alone is qualified for, appropriate to, and capable of being spoken within the academy and the pursuit of mathematically significant or viable lines of inquiry.

Bourdieu is also referenced quite frequently by those who make their home in the discipline of literacy studies; given the suggestion that mathematical language may be taken as a veritable form of literacy in its own right, it may be in our better interest to agree on a solidified

definition of what exactly the term “literacy” means in this section. In its simplest form, *literacy* is perhaps most easily understood as one’s ability to read and write in their native language, or the process by which one acquires those skills (Gee, 1990). While it is tempting to default to this interpretation, a trap that many fall into in popular discourse, our inclination to embrace such a narrow perspective limits how expansive our understanding of literacy could truly be. Anthropologist and sociolinguist Perry Gilmore (2003) posits that “[t]he concept of ‘literacy’ [...] is [typically] reduced to numerical reading scores, percentiles, and grade levels [...] [W]hat we might loosely identify as literacy involves a complex and widely ranging set of discursive (oral and written), cognitive, social, and relational practices, behaviors, and understandings” (p. 10). It is this type of expanded approach to literacy, and a willingness to recognize its connections to societal and ideologically motivated practices, which is the focus of scholars of literacy studies.

Alternately known as *literacy education*, this subfield of research within educational studies works to situate the notion of literacy and its associated literacy practices within a constantly changing and often dialectical, or mutually reinforcing, sociocultural context and framework. Literacy education researchers, scholars, and policymakers seek to illuminate the role of literacy, among other things, in providing access to political power, in the construction of group and individual social identity on the basis of linguistic similarity and difference, and in the reproduction of structural hierarchies founded on race, class, gender, and language (Chavez, 2020; Ferguson, 1980; Freire, 2018; Gee, 1990; Gilmore, 2003; Hall, 2003; Kramsch, 2008; Lyiscott, 1989).

Any discussion of literacy would be incomplete without mention, at the very least, of Brazilian educator and activist Paulo Freire and his landmark *Pedagogy of the Oppressed* (2018). In his framework of *critical literacy*, Freire calls for educators to embrace *conscientização*,

loosely translated as “critical consciousness,” the ability to perceive social, political, and economic contradictions within society that are reproduced within academic institutions (p. 35). *Conscientização*, according to Freire, serves as the primary vehicle for both the oppressed and the oppressor, who are perpetually embroiled in conflict with and necessarily depend on each other, to achieve liberation from oppression. Much like Bourdieu, Freire recognizes that schools often mandate the use of arbitrary standards which are closely aligned with, and often work to reproduce, existing social hierarchies. Importantly, he explicitly introduces an added dimension of social control: students are actively instructed, though they may not realize it, to remain oblivious to, or uncritical of, the role of these systems in their own subjugation. One of the primary ways this is achieved is by reliance on the “*narrative* character” of teacher/student relationships, which positions students as “patient, listening objects” who absorb “lifeless and petrified” information, as the teacher as “narrating subject [...] talks about reality as if it were motionless, static, compartmentalized, and predictable” (p. 71). This is also accomplished through adherence, whether subconsciously or otherwise, to the notion of *banking education*, the idea that knowledge flows unilaterally from teacher to student, where the teacher serves as the actor, the limitless font of knowledge, and the student as the passive, empty receptacle to be filled by their teacher, and thus incapable of challenging their authority over the knowledge presented and the form in which it is expressed (pp. 72–73).

Many progressive literacy scholars also emphasize their support for linguistic diversity among students as an asset and a resource in the classroom to be celebrated, rather than an obstacle to student learning to be dismissed or discouraged (New London Group, 1996). This premise is shared by, and fundamental to, *multicultural education*, the synthesis of a variety of pedagogical orientations which has seen a degree of recent appreciation from an array of

progressive educators. Among other things, a multicultural approach is presented as a process of comprehensive school reform geared towards social justice, antiracism, and language diversity, with the capacity to evaluate the role of antiracism and antidiscrimination in the classroom; the presence of structural factors which hinder student learning; the impact of culture, as a site of ideological tension, on academic institutions, experiences, and outcomes; and the need to incorporate language diversity within schools — all of which are presented as fundamental knowledge for both students and educators (Nieto, 2000). Each of these tenets may be adopted in order to create actively antiracist, linguistically diverse, and intellectually engaging communities of mathematical learning (Su, 2017).

Because multiculturalism is in many ways both an aim and a process, rather than a set theory, it encompasses various tailored approaches, among which there are several that I believe may be relevant to mathematics classrooms. *Heteroglossia*, or a *heteroglossic language ideology* (as opposed to a *monoglossic* one), originated by Russian philosopher and literary theorist Mikhail Bakhtin, problematizes hierarchies of language use by positioning multilingualism, rather than monolingualism, as the norm (Machado, 2017). Heteroglossia seeks to understand languages, dialects, and vernaculars not as discreet and static, but as complex, interconnected, and intergenerational forms of communication shaped by competing ideological motivations, both in response to their past and in anticipation of their futures (Blackledge & Creese, 2014). Closely connected to heteroglossia are pedagogies of *multiliteracies*, which instruct students in the traditional codes of power while also actively accounting for and inviting the culturally and linguistically diverse social locations of their students (New London Group, 1996). By structuring spaces where those who do not or wish not to speak the language of power, or who marry it to the use of their own vernaculars and dialects, can be recognized and celebrated,

multiliteracy ultimately ensures that "differences of culture, language, and gender are not barriers to educational success" (p. 61).

Many multicultural educators also champion *culturally relevant* (Ladson-Billings, 1995) and/or *culturally sustaining pedagogy* (Machado, 2017); hoping to more closely align classrooms with the lived experiences and unique cultures of students of color in particular, both pedagogies foster and sustain linguistic, literate, and cultural pluralism as an explicit goal of the educational process by inviting students to become "strategic users of language" (Machado, 2017, p. 3), capable of effectively engaging with and navigating the language of power, popular literacy practices, and the own vernaculars and dialects. Not only does this allow for a break with traditional deficit or disadvantage models of linguistic pluralism, these strategies also help students become more comfortable with and confident in their identities, recenter motivation in the narrative of achievement, and provide regular opportunities to challenge the inequities that are often perpetuated implicitly in schools and other societal institutions (Ladson-Billings, 1995).

Gholdy Muhammad (2020), expanding upon the principles of culturally relevant pedagogy introduced by Gloria Ladson-Billings (1995), also proposes a *historically responsive literacy*. Centered on Black literary traditions during antebellum slavery and in the literary societies that formed in Black communities across the United States during the 1800's, where access for Black people to education was explicitly curtailed, this approach to literacy "authentically draws upon and responds to the histories, identities, and literacy and language practices of students" (Muhammad, 2020, p. 49). Much like Freire, Muhammad suggests that literacy is not "just a set of skills to possess, but the instruments used to define [one's life] and the tools to advocate for [one's] rights" (p. 9). A pedagogy designed to center and benefit those who are most marginalized in our society, which provides constant opportunity for them to see

themselves reflected in their curricula and instructs them on how best to call out injustice and develop the agency and self-empowerment to envision better worlds than our own, inevitably works in the best interest of all students, not uniquely students of color.

In this paper, I submit the proposition that, understanding that the language typically encountered in academic or professional mathematical spaces comprises a set of not only reading and writing practices, but also serves in a variety of socially interactive and dialogical, behavioral, and comprehensive functions, we might accept a perspective of mathematical language as a veritable form of literacy, and thus one that is similarly embroiled in social, political, cultural, and ideological conflict. Doing so, I now turn to a review of prominent scholars, texts, and theories within the field of literacy education — including Bourdieu, Kramsch, Freire, Muhammad, and more — to discuss, and both quantify and qualify, what exactly may be implicated in the unchallenged, outsized reliance on this language within those and other specialized spaces.

Literature Review & Discussion

Linguists and social anthropologists alike have long concluded that the hierarchies of language that professional spaces tend to enforce are largely contrived, and that all dialects, vernaculars, and modes of communication both within and between languages possess equal, legible conventions of grammar that provide for effective communication between interlocutors (Flores & Rosa, 2015; Savini, 2021). In fact, in a comparison between African American Vernacular English (AAVE) and Standard American English (SAE), James Paul Gee (1990) actually offers that some sociolinguists have "demonstrated that working-class [B]lack youths' speech has all the qualities generally associated with logical thought, while at the same time showing that much middle class speech is overly verbose and disorganized" (p. 50). Returning to the four axioms provided by Federico Ardila-Mantilla (2017), that "[1] Mathematical talent is distributed equally among different groups, irrespective of geographic, demographic, and economic boundaries [...] [2] Everyone can have joyful, meaningful, and empowering mathematical experiences [...] [3] Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs [...] [4] Every student deserves to be treated with dignity and respect" (p. 1164), we may extend this notion to the literacy practices of linguistically diverse mathematics classrooms as well.

While it may be easy to simply accept these axioms and believe them to be true, adopting them in practice given the current structure of the majority of mathematics classrooms is much more difficult than we may be inclined to give credit. One of Bourdieu's multitude observations of the culture among intellectual elites is a certain "interest in disinterestedness" which problematizes Ardila-Mantilla's considerations. As a student in the French education system, Kramsch (2008) notes that Bourdieu recognized a tendency among instructors to reward a

student's innate talent and, especially, their rhetorical skill — an ability which those in positions of financial privilege were far more likely to possess, or more appropriately, be presented with adequate time and opportunity to develop — rather than their hard work, their dedication to their craft, or their personal conviction, qualities which were much more likely to be appreciated among those of lower socioeconomic status (Kramsch, 2008; Lareau, 2016). He noted that the style in which a concept was expressed bore much more significance than the concept itself. Educators, in other words, grew to favor eloquence over ability, style over content.

This is all too often the case in mathematics classrooms from elementary to graduate school. As both a student and an occasional instructor of mathematics, it has become abundantly apparent through both my own lived experience and through the observation of others', both my students' and my peers', that aspiring mathematicians are expected to adhere to traditional codes of mathematical literacy wherever possible. In my own education this has been most apparent in proof writing, where even the slightest variations in a format that already appears contrived and unnecessarily formal may be penalized, interpreted as leading to miscommunication. I have witnessed students on several occasions, especially younger children, articulate mathematical concepts in coherent and accessible ways that clearly signal their intuition, but ultimately be corrected or dismissed by their teachers or professors — if not one of their classmates — for not using the proper terminology. As an instructor, it was often impressed on me that I was to be the one encouraging and practicing this correction. While it may not be malicious, the message is communicated loud and clear that this "interest in disinterestedness," far from unique to the French educational context that Bourdieu was situated in, is to be practiced and preferred.

The kind of system within which this type of virtue signalling takes place inevitably possesses a great degree of symbolic power due to the kinds of distinction which it offers — a

degree or academic title, the value of name recognition, and so on — and thus has the capacity to commit enormous acts of symbolic violence. However, somewhat subversively, it is in the institution's best interest to minimize the amount of power that they perceivably wield. Though the system may well be designed to reproduce the speaking and writing styles of the bourgeois elite, admitting this outright would only serve to expose the inner machinations of not just its own but other societal institutions (Kramsch, 2008; MacLeod, 2009; Sojoyner, 2017). Not only would this compromise their legitimacy, but especially in the case of education, its narrative as the "great equalizer" and the promise of social mobility for students, regardless of background, that it offers would inevitably come under fire.

As a result, instructed to remain oblivious to and uncritical of this process (Anyon, 1980, 2011; Chavez, 2021; Ferguson, 1980; Freire, 2018; MacLeod, 2009), students are left to feel personally responsible for their own failings in academic spaces, precisely because for the vast majority, they are unable to recognize just how enormous an amount of power the institution has access to (Kramsch, 2008) and the hidden curriculum which they are being instructed in (Anyon, 1980). Further exacerbated by the fact that all too many math students are not afforded the opportunity to engage with mathematics in a manner that is intuitive and interesting to them, and thus are never able to resonate with or truly grasp mathematical concepts, those studying mathematics in particular may find themselves in classrooms where they try and often fail to make sense of the symbols, formulas, and variables presented to them, perhaps that they had never previously been exposed to and encounter for the first time in that very classroom. Offered little external support, as these students watch their other, often privileged classmates succeed, they come to the natural conclusion that they are, in fact, wired differently, programmed not to be successful at mathematics. Other students may succeed, not because they conceptually

understand what is being represented, but because they recognize and are capable of blindly replicating the procedures demonstrated by their teachers without any understanding of why they are doing it. And others still may understand the process on a conceptual level, but when faced with a depersonalized and unnecessarily abstracted approach to pedagogy, find that they lack the resources to translate between what is in their heads and what is on the page. As a result, their contributions are written off by their peers and educators, who believe that their inability to express those thoughts conveys their mathematical insignificance or invalidity.

In the case of mathematical institutions, students are not only asked to use the language of power, but told that it is a necessity should they desire access to positions of distinction within the field in the present or future, or even if they simply wish to be taken seriously as bonafide mathematicians — to speak, "but not to exercise voice" (Chavez, 2021, p. 1), to "bow[] silently" (p. 7) as they are instructed to reproduce the modes of speaking and writing practiced by their peers and professors. Language becomes a means not for students to embrace their own voices, but rather a tool for their induction into a "matrix of silence [...] so profound it enlists [students] of color to eradicate [them]selves" (p. 2).

As form takes on greater and greater importance in relation to content, the potential consequences grow increasingly compromising. Even should students conceptually understand the mathematical principles themselves and how to use them — in other words, achieve content mastery — their legitimate participation in the field is conditional on the language they use to convey that comprehension, and their displays of proficiency are at greater risk of being ignored in the event that they do not accurately conform to the generally accepted narrative of what constitutes a "mathematically literate" student. Novel approaches to material or even potentially revolutionary mathematical ideas generated by these students may be written off entirely, simply

because they do not abide by an arbitrary set of standards maintained by an elite and exclusive group of mathematicians. Their intelligence is measured not by their fundamental understanding, but by their ability to effectively deploy and leverage mathematical language in academic spaces. As mathematicians become increasingly insistent on inflexibly mandating this sort of communication, it follows that one's inherent mathematical prowess becomes conflated with the level of one's mathematical literacy.

It goes without saying that a discussion of capital factors crucially into this discussion. As Jamila Lyiscott (1989) aptly and eloquently states in *Black Appetite. White Food.*, "Black and Brown bodies remain trapped in other people's narratives of what educational success, achievement, and brilliance must look like" (p. 19), a statement that is unfortunately just as resonant over thirty years after its writing. While it is important to recognize that class and race cannot be reduced to having identical impacts on a student's educational maturity, it is impossible to ignore that many students from minoritized racial backgrounds are often forced by means outside of their control into positions of economic marginalization as well. It is precisely these Black and Brown students at the intersections of various disempowered social locations who all too often do not have the kind of capital that would allow them to make the same kinds of connections afforded their wealthier white peers, whether in the form of teacher quality, parental involvement, or access to resources such as tutoring, educational technology, or other academic materials provided by school funding (Anyon, 1980; Bourdieu, 2016; Lareau, 2016; Lyiscott, 1989; Parrish & Cobb, 2001).

On the other hand, many — once again, more often than not, these same Black and Brown students — may be intentionally excluded from this understanding of mathematics precisely because those with power and capital, those who speak the language effectively,

recognize the benefits it provides and wish to distance those they have deemed unworthy from access to positions of privilege or distinction (Chavez, 2021; Kramsch, 2008). Proficiency in mathematical language becomes, to borrow from Bordieu's terminology, both a form of capital within the field and a sign of distinction as a mathematician, and more generally as an academic, that may be weaponized in order to perpetrate the symbolic violence of exclusion and gatekeeping (Bourdieu, 2016; Kramsch, 2008); and to borrow that of Roxane Gay, through Lyiscott, it is arguably transformed into a kind of "privilege," a certain benefit, advantage, or favor (Lyiscott, 1989, p. 28). For those who recognize it, preserving mathematical literacy's inaccessibility becomes a means of securing, retaining, or otherwise protecting one's own privileged position within the discipline, reaffirming the existing hierarchy or their claim to authority within the mathematics classroom. (Chavez, 2021; Kramsch, 2008; Lyiscott, 1989). Subversively, it becomes entirely possible for academics and mathematicians to hide their own biases behind a Standard Language Ideology that is itself biased towards abstracted, idealized, and non-varied spoken language (Lyiscott, 1989; Savini, 2021), all of which are, it should be noted, closely aligned with power. Furthermore, because it has become institutionalized, these educators are at total liberty to impose the language of mathematics on their students without repercussions, let alone that they are expected to do so in the ostensible pursuit of "educating" their students on the use and practice of effective mathematical jargon. Hoping to exploit its gate-keeping potential, they are able to mask the symbolic violence it commits behind the veneer of objectivity and the promise of equal access so adored by those who make their home in the discipline (Koblitz, 1981).

These students become fugitives within their own education (Lyiscott, 1989; Sojoyner, 2017); while they may not suffer exactly the kinds of explicit psychological and emotional

violences that Black students in particular may encounter while navigating spaces of higher education more broadly, which defines "fugitivity" as a term unique to the Black student experience, they nonetheless similarly find themselves in locations where their attendance may be encouraged, actively sought out, or perhaps even required, but which fail to account for the various supports they may need or the types of suffering they may encounter by way of their invitation into such spaces. Unequipped or unprepared to address this symbolic violence, they are forced to grapple with institutions unable or unwilling to address their needs, and in order to survive must exercise various resistance practices that are detrimental to their mental, emotional, and/or academic health in the long run, provided that they do not choose to remove themselves from those spaces entirely (Lyiscott, 1989; Savini, 2021).

While these acts of subtle rebellion "disrupt[] white authority over Black bodies and author[] possibilities beyond the permission of white power" (Lyiscott, 1989, p. 71), exposing "the facade of state power" (Sojoyner, 2017, p. 517) and often breeding collectivity among these students by depending on their shared lived experience with the academy, these practices are ultimately unsustainable and unhealthy. Even in acts of refusal, Sojoyner discusses, "[n]ot appreciated as a legible form, Black intellect is cast aside as a social pariah [...] schools imbue psychological trauma onto Black youth and attempt to cultivate an internalized rationale of incompetence/indolence. Thus schools as enclosed places operate to diminish/rebuke/castigate any Black intellectual capacity that does fit into the prescribed, hierarchical arrangement of racialized subjects" (Sojoyner, 2017, p. 523). It is important to uplift that the authors focus on Black codes of knowing and being in particular, and that the logic of fugitivity is itself unique to the Black experience. However, the underlying logic and associated lack of support may be extended to students whose habitus includes any codes not traditionally aligned with whiteness.

In a sense, all four "I's of Oppression" (namely ideological, institutional, internalized, and interpersonal), adapted by Lyiscott from the Global Action Project, are embodied in the particular case of the mathematics classroom. *Ideologically*, — which includes "[c]ollective consciousness, norms, silent beliefs and ideas about different groups" (Lyiscott, 1989, p. 73) — the ways of knowing of those who do not speak in a hegemonically "mathematically literate" sense are denigrated, whether internally or in outright communication between peers and/or professors. *Institutionally*, — which encapsulates "[t]he network of institutional structures, policies, and practices that create advantages and benefits for some, and discrimination, oppression, and disadvantages for others" (p. 73) — assessments, standardized tests, and classroom policies tend to reward students for practicing this kind of literacy, and dock points for those who do not. With respect to *internalization* — "[t]he process by which a member of an oppressed group comes to accept and live out the inaccurate myths and stereotypes applied to the group by its oppressors [and by which] a member of a privileged group comes to accept and live out inaccurate beliefs of normativity and/or superiority in relation to other groups" (p. 74) — students incorporate their failures into their identities, casting doubt on their own abilities while uplifting dominant forms and narratives of mathematical literacy as the lone mode of acceptable mathematical expression. And finally, *interpersonally*, — which accounts for "ways in which ideological, institutional, and internalized privilege and oppression play out in everyday interactions between members of privileged and oppressed groups" (p. 74) — teachers and students alike may be expected to police the ways in which students feel comfortable offering up their ideas or articulating their thoughts. They become victims of Bourdieu's symbolic violence, not only by "those who possess symbolic resources over" them but, crucially, "taking [it] as the

natural and necessary order of things, they are actively complicit in their own subjection" (Kramsch, 2008, p. 42).

Our discussion here is also very closely connected to the twin premises of appropriateness and professionalism. Literacy scholars Nelson Flores and Jonathan Rosa (2015) note that even when we do seek to invite linguistic diversity into the classroom by way of additive pedagogical practices, they are often situated within a "discourse[] of appropriateness" which positions "standardized linguistic practices as objective sets of linguistic forms that are understood to be appropriate for academic settings" (p. 150). In other words, they suggest that we tend to naturalize the notion that, not only is this language bounded and ahistorical, but that there is a time and a place for particular types of language, to be assessed on a situational basis. I have certainly had this confirmed, on multiple occasions, in my own experience; the informal discussion of mathematics is rarely legitimate in the classroom, and even in informal situations (such as a professor's office hours, for example) the tendency is to always default to the language of the mathematics classroom, even when it is clear that that language is the obstacle to success that brought students to those situations in the first place.

While this practice is seemingly innocuous, and certainly commonplace in the discipline of mathematics (if not, to be fair, the vast majority of academic disciplines) the authors invite us to consider that in abiding by this notion, we in fact become complicit in "the reproduction of racial normativity [and the white gaze] by expecting language-minoritized students to model their linguistic practices after the white speaking subject" (p. 151). We center not only the "white" speaking subject, whether in the form of the mathematically literate "math bro" or the professor aligned with traditional mathematical literacy, but also the primacy of academic language, positioning non-standard linguistic codes— and thus the people who speak them — as

peripheral at best, or detrimental at worst to a positive, enriching, and successful classroom environment.

Similarly, it is well documented that the idea of professionalism in comportment, dress, and language use in educational and other professional spaces is heavily aligned with white supremacy, and often encodes thinly veiled racism, sexism, and classism (Jones & Okun, 2001). Per Aysa Gray (2019) for the *Stanford Social Innovation Review*: "[i]n the workplace, white supremacy culture explicitly and implicitly privileges whiteness and discriminates against non-Western and non-white professionalism standards related to dress code, speech, work style, and timeliness" (para. 1). Speaking codes other than Standard Academic English in professional spaces such as the classroom may be taken as a sign of hostility or disrespect, then, in systems which display a commitment to "white professionalism" (para. 14) in their language standards; the author even remarks that "[v]ocabulary and syntax can also be a means for employment discrimination [...] [as] the push in academic and corporate spaces to use unnecessarily complex vocabulary, syntax, and jargon [become] accepted codes of biased professionalism" (para. 15). Understanding both appropriateness and professionalism as manifestations of Bourdieu's symbolic violence is far from a stretch, and in light of the literature above, connecting them both to the use of mathematical language appears to be a natural next step.

Both Lyiscott and Kramsch touch on the notion of giving students a "voice" by way of instructing them in the dominant forms of literacy, a "fundamental paradox [that is] both liberatory and conservative, an instrument of both social change and social reproduction" (Kramsch, 2008, p. 45). In mathematics, this typically takes the form of the impression of particular terminology upon students as it is applied to describe or explain specific mathematical phenomena. Not only does this invoke Flores's and Rosa's discussion of appropriateness above,

it similarly speaks heavily to Lyiscott's discussion of paternalism, the implication that these students are "voiceless until some salvific external force gifts them with [both the tools and] the privilege to speak" (Lyiscott, 1989, p. 34; Chavez, 2021), in an act of what Paulo Freire might discuss as the "false generosity" of the oppressor (Freire, 2018, p. 59–61). Gholdy Muhammad also reminds us that "educators don't need to empower youth or give them brilliance or genius [when] the power and genius is already within them" (Muhammad, 2020, p. 13), especially in light of the above consideration by Flores & Rosa, Gee, and Savini of the equal efficacy of diverse linguistic practices and the axioms of mathematics embraced by progressive mathematics educators such as Ardila-Mantilla.

Mathematicians rely on mathematical literacy as a depoliticized and morally neutral tool, a practice which fits nicely into the narrative of academic spaces and of pure mathematics as a discipline as ideologically neutral and meritocratic (Chiodo & Bursill-Hall, 2018; Folkerts et. al., 1999; Hardy, 1940; Koblitz, 1981; O'Neil, 2016). But accepting an attitude such as this erases that proficiency in mathematical language is, ultimately, another way in which alignment with whiteness as a product of centuries' worth of oppression can be approximated. Lyiscott addresses, namely, the history of European invasion and imperialism as one which dictates social standing on the basis of proximity to whiteness and/or white aesthetics or standards (Lyiscott, 1989). Often unintentionally, the unquestioned reliance of the mathematical community on mathematical language serves as an extension of this same process of colonization, imperialism, and racism, as the author so eloquently states: "a huge aspect of the colonial subjugation process was controlling the language of students in school, specifically [...] divorcing the language of the home/community from the space of school [...] [seeking] to police the language of the oppressed peoples as a means of subjugating their bodies" (pp. 38–39). We, as mathematics educators, may

see access to the specialized language we so heavily rely on as a form of agency and empowerment, or perhaps even one of liberation for our students; after all, it expands their lexicon and provides them access to new ways of thinking about and discussing mathematical concepts, approaches and frames that may not have otherwise come naturally to them. It is both comfortable and comforting to think this way. And yet, it is also exceedingly paternalistic. Students' voices are not liberated, as we perhaps wish them to be; they are stifled, forced into oppressive modes of dialogue and arbitrary reproductions of form which minimize and trivialize their own thoughts, veritably abstracting them from their own knowledge and comfortable ways of knowing.

The idea of mathematical language, with its explicit focus on inflexible commitment to a language rooted in the modes of expression favored and practiced by the social elite, seems distinctly at odds with the tenets of multiculturalism and the belief in asset-oriented approaches to linguistic diversity to which proponents of multicultural education and its associated strategies hold fast. It goes without saying that approaching mathematics pedagogy in such a rigid and precise manner has the potential to stifle linguistic diversity within the classroom, by denying opportunities for students to engage the variety of vernaculars or perspectives that they bring to the table, and that enrich not only the classroom experience but their own understanding of the material they encounter. But it also has the power to create inferiority complexes among students to whom mathematical language does not come naturally, and especially among those who have demonstrated previous success in the discipline that was compromised upon transitioning to a more "rigorous" environment (Ardila-Mantilla, 2016; Bauer-Wolf, 2019; Chavez, 2021; Jones & Okun, 2001; Lyiscott, 1989). Not only might these complexes last a lifetime, leading individuals to feel that they are unequipped for a future in the discipline, it also creates hierarchies of

language that further castigate dialects such as AAVE, for example, relegating them to a lower caste by deeming them perpetually unfit for academic spaces, implicitly designating them and the insights they may produce, to borrow mathematician G. H. Hardy's terminology, as "ugly" (Hardy, 1940, p. 14). Returning to Lyiscott's words once again: "[i]n order to survive predominantly white schools, people of color know intuitively that 'access' means assimilation and that 'excellence' means erasure of the self" (Lyiscott, 1989, p. 70). Success within the discipline for all to many, then, means that they must leave their identity at the door.

A diverse classroom in general, not uniquely one of linguistic diversity, can also become difficult to maintain. Given that the dominant mode of understanding mathematics is highly abstracted and dehumanized with little connection to the real world (Hardy, 1940), an awareness that I can readily confirm from my own experience as a mathematics student, it follows that the types of pedagogy embraced by math teachers will often be similar in its orientation and approach. For many students, this approach is intuitive, or at least has become manageable as they have grown increasingly familiar through their enculturation into academized mathematical spaces. But this is not the case for many others including, but not limited to, students with different learning styles who are more equipped for kinesthetic or interpersonal pedagogical approaches; students in the process of learning English, or the language of their mathematics instruction, as a new language; students who do not have the financial means to access tutors or other academic supports to supplement their experiences in the classroom; and students with learning disabilities for whom such a disconnected manner of teaching typically does not register. For one, in the spaces that form as a result, as aspiring mathematicians with diverse backgrounds and needs filter out what remains is a homogenization of thought as well as of demographic.

But for those who stay, it may also breed resentment at an early age for the discipline as a whole, which leads many away from considering career trajectories in math or the sciences (Parrish & Cobb, 2001), and may even put students in compromising situations or otherwise at a disadvantage when considering careers outside of mathematics, due to their underperformance in core STEM classes. In other words, this can threaten a student's self-concept of self-definition as a competent mathematician, or even as a competent student given the centrality of mathematics instruction to almost every academic institution. It also curtails the list of what Hazel Markus and Paula Nurius (1986) discuss as an individual's "possible selves" (p. 954), manifestations of one's hopes, fears, goals, threats, and general conceptions of potential for the future which frame and guide their behavior in the present. Stifling linguistic diversity in the classroom, then, can also stifle motivation: even those who may wish to continue studying mathematics may be forced to grapple with the awareness that their future success in the discipline is contingent on their ability to assimilate into an inaccessible mode of approaching content. Faced with this reality, and reinforced by the problem of representation which presents few role models or aspirational figures to look up to who look, think, or talk like them, they accept that there is no point in trying. They are implicitly told that this future is, for them, unimaginable and unattainable (Ardila-Mantilla, 2016; Bauer-Wolf, 2019; MacLeod, 2009; Markus & Nurius, 1986, Martin, 2009; Muhammad, 2020; Su, 2017).

Another obvious implication of the increasing technicality of the vast majority of mathematical writing is the question of accessibility, not only to mathematicians from marginalized groups who seek a place for themselves in the discipline, but to a wider, non-mathematical audience as well. Mathematical literacy, it can be argued, creates a mathematical elite among those with a demonstrated proficiency in the terminology (Chavez,

2021), even if only because there is an enormous amount of insider knowledge that is required to follow along with, much less to understand, any high-level mathematical innovation. As a result, the discipline has become exceedingly insular and exclusive; while mathematicians, by-and-large, already pursue knowledge as a self-indulgent intellectual exercise for the sake of simply pursuing knowledge, removed from moral or ethical concerns (Hardy, 1940; Shulman, 2002; Su, 2017), they write predominantly to an audience of other mathematicians, with little consideration towards the applications of their work, believing it to be sufficiently abstracted from the physical world so as to absolve mathematicians of their obligations to it (Koblitz, 1981; Shulman, 2002). This is only enabled by the degree of prestige which mathematicians are generally awarded, seen even at the level of funding for mathematical research or the degree of importance that math is assigned in relation to other disciplines such as the arts or humanities in public discourse (Moses & Cobb, 2001). It goes without saying that many are excluded, some innocently, and others intentionally as mathematicians themselves develop an outsized sense of self-importance in their work and their competence (Chavez, 2021). It is also worth mentioning that the potential for meaningful interdisciplinary collaboration also diminishes as mathematics becomes increasingly self-serving and isolated.

But thinking ethically, unless accessibility of language is an explicit goal, the harms perpetuated by mathematicians may extend beyond the physical space of the academic or professional classroom, hall, or convention, and symbolic violence may be transmuted into very real, physical injustices; and, to some extent, it is reasonable to believe that they already have. Certainly, while the tendency is to view mathematics as abstract, speculative, and impersonal, it is continually implicated in the presence of moral and ethical quandaries, including predictive policing (Angwin, Larson, Mattu & Kirchner, 2016; Lum & Isaac, 2016), gerrymandering,

redlining, and similar practices (Duchin, 2018), facial recognition software (Williams, 2015), and a host of other algorithms which rely on biased statistics or have been proven themselves to encode implicit bias (O'Neil, 2016). Mathematicians have total liberty to make human rights abuses or ethically compromising decisions behind layers of mathematical jargon that only fellow mathematicians have the capacity to navigate. Whether they use it or not, these thinkers have the power to get away with saying or doing virtually anything they wish through the power of "mystification, intimidation, [and] an impression of precision and profundity" (Koblitz, 1981, p. 113). At the end of the day, after all, no one but them knows what is being said, and the recalcitrance of many mathematicians to engage in ethical discussion shields them from much potential criticism (Chiodo & Bursill-Hall, 2018). The less human the language becomes, the easier it is to ignore its very real, very human implications.

Author Cathy O'Neil (2016) describes a Weapon of Math Destruction, or WMD for short, as a mathematical model, algorithm, or similar phenomenon that meets three particular criteria: "Opacity," the notion that it is both widely accessible and that its machinations are legible and transparent; "Scale," the premise that it is abundantly far-reaching, or the level to which it is ingrained in various facets of our society; and "Damage," the capacity that it has to create excessive and unnecessary collateral harm in its application. Ostensibly, these WMD's are created with the intention of excising bias and minimizing human error, but in practice, often serve to uphold white supremacy and existing structures of power, reducing humans to data points rather than individuals and leading to the manifestation of new, unforeseen biases in their treatment as such. Seen as a particular tool, it follows that mathematical literacy seems poised to become a WMD, assuming of course that it does not already function as one. Of the three criteria, the first is perhaps the most difficult to evaluate. The type of language preferred within

the community is itself quite clear, meaning that it should theoretically be easy enough to gain access to, to reproduce, and ultimately to understand. However, the intricacies of its syntax are often so specific, formalized, and mystified that actually going about achieving this enlightenment without extensive study or assistance is far less straightforward than one might be led to believe, suggesting it is not quite as opaque as it appears. The scale of its use, by comparison, is immediately obvious. Mathematical language can be found no matter where one looks within the discipline, whether in the classroom, on mathematical forums, or in academic journals, all of which are laden with specialized terminology. Its potential to cause damage, it goes without saying, has already been discussed in great detail.

One such case of this damage which has yet to be discussed, but one that is common to a number of the WMD's offered by O'Neil, is the feedback loop that it engenders. While not an explicit qualification of a WMD, the vast majority of them are often broadly generalizable and self-reinforcing, and serve to perpetuate and exacerbate existing societal ills including racism, discrimination, and socieconomic inequality by feeding into themselves (O'Neil, 2016).

This kind of feedback loop is all too apparent within the discipline, if only one should choose to look. All of the literature that has been discussed up to this point seems to support the proposition that those with mastery over mathematical literacy are the ones who disproportionately, if not exclusively, gain access to positions of authority and distinction within the discipline; granted access to leadership roles within these spaces, they are the ones who thus become responsible for creating the rules, codes of conducts, and sets of standards to be adhered to by the following generation.Whether intentionally or otherwise, given the power and opportunity to do so, they reward those who think and talk like them, and thus reinforce the primacy of the language. As a result, the cycle continues, reproducing the styles of literacy

favored and practiced by the elite and the marginalization of non-white, non-male, and other minoritized students within academic and professional mathematics spaces, all couched in an illusion of objectivity, the false promise of meritocracy and equal access, and an argument of necessity on the basis of effective communication.

Conclusion

Accepting the notion that mathematical language is itself a form of literacy, that encodes particular biases and rewards modes of thinking, speaking, and doing that have historically been aligned with the dominance of whiteness, maleness, heterosexuality, and socioeconomic advantage in industrialized society; that, in order to be practiced and understood, depends on access to forms of cultural, social, economic, and symbolic capital; that simultaneously keeps out and keeps in entire demographics of students and mathematicians — it is clear that this language often manifests in exceedingly problematic ways, and thus carries with it a series of implications that underserve a significant portion of the population, often before they have even entered into the discipline itself. Should we choose, to borrow O'Neil's (2016) terminology, to conceptualize the form and function of mathematical language as a Weapon of Math Destruction, the question we must inevitably ask ourselves is, "How do we challenge it, so that it no longer acts as one?" And if it has yet to achieve veritable WMD status, we might instead ask, "How do we prevent it from becoming one?"

Before offering potential solutions, it is important to discuss that mathematical language in fact can be, and often is, an incredibly useful and effective tool. The intentions behind its rise, for all intents and purposes, may well be entirely pure, as if often the case with similar exercises in standardization and generalization. And if not pure, then those motivations are certainly understandable: uniformity of language is abundantly practical as it minimizes the potential for miscommunication, provided that all of those engaged in conversation with each other share the same degree of facility with the intricacies of the language. A certain clarity and specificity is achieved in conversation between mathematicians with access to this literacy, then, that may otherwise be rather difficult to approximate in regular conversation.

It does not, however, have the same kind of feasibility for determining who is or is not good at mathematics, simply buying into the notion that certain students or demographics of students are innately predisposed towards success or failure within the discipline, and that this proficiency may be assessed by the level of mathematical literacy which they comfortably display. Mathematical language is only useful when it is used as a benchmark of student progress, not as a signifier of their mathematical ability. It serves both educators and students well when it is seen as a tool to assess where students are in their mathematical thinking at a given point, and as impetus for educators to tailor their pedagogy and methods of assessment in order to further their students' development as mathematical thinkers.

In light of the above, despite the often problematic ways in which it manifests, as it currently stands I do not believe that dispelling with mathematical language in its entirety is a feasible or useful suggestion, although I do believe it to be a goal that future generations of mathematicians should, at the very least, seriously consider working towards. In the remainder of this section, I lay out a series of suggestions that mathematicians and math educators may adopt or ponder on their own as potential action items. My hope is that, by actively engaging with these and other recommendations, the discipline may collectively move towards a more holistic, equitable, and stimulating approach to the teaching and doing of mathematics.

1. A critical, situated perspective of the role of mathematical language in academic spaces.

For those who wish to enter the field, it is crucial that educators provide them with the tools to do so; in other words, we must provide all students with equal opportunity to learn how to "talk the talk," recognizing that as it is currently structured, the discipline actively seeks to reward those who are capable of displaying their proficiency with this form of literacy. But in

doing so, we must also remember not to become complacent. In the words of Audre Lorde (2020), "the master's tools cannot destroy the master's house" (p. 102) — "when the tools of a racist patriarchy are used to examine the fruits of that same patriarchy [...] only the most narrow perimeters of change are possible and allowable" (pp. 102, 100–101). And, while access to these empowered codes in and of itself may be useful for entry into positions of power, it is not predictive of sustained success, and does little to disrupt the underlying ideologies which reify their dominance (Gallego & Hollingsworth, 2000).

In *Pedagogy of the Oppressed*, Paulo Freire (2018) is very intentional and explicit in urging his fellow academics to invite their students, wherever possible and from a young age, to engage in a process of active reflection with respect to their position in society, the role of language in reproducing or potentially altering that position, and the knowledge that they are presented with by way of the process of formal education. Rather than accepting at face value from their instructors, or those in positions of power, that this knowledge is objectively true and cannot be questioned, by engaging in the practice of critical literacy students should be encouraged to expose and contest contradictions in society which are reproduced at the level of the language, knowledge, and relationships of power within academic spaces.

Literacy scholars have long accepted that literacy — whether through reading, writing, speaking, or other literacy practices — is not an "artifact" removed from individuals or from real-world, sociocultural contexts but rather "a political, historical, and ideological act steeped in identity politics" (Chavez, 2021, p. 10; Luke & Freebody, 1997; Winner, 1980). They accept that no language or code is neutral, but rather that every literacy practice is inherently entrenched in a legacy of social and political decisions, is built on some individual's or group of individuals' perception of their reality and their perspective of what is and is not important to know, and must

inevitably include certain voices at the expense of others (Hall, 2003). Mathematicians too, then, must be willing to address and challenge the false narratives of neutrality and meritocracy within their classrooms and that often accompany insistence on the continued, unquestioned use of mathematical language, rather than believing that simply admitting their existence is sufficient.

Access to the language of power means nothing if educators are not intentional in also dispelling the myth that there is only one correct or intellectually sound way to engage in mathematical discourse. Founded in research that all linguistic codes are equally capable of and viable in the processes of meaning-making, illumination, and communication (Flores & Rosa, 2015; Gee, 1990; Savini, 2021), they must take every opportunity possible to remind their students that though it may be fundamental to the discipline, mathematical language is an artificial construct designed (to some degree) to benefit certain individuals and disadvantage others with, ultimately, no bearing on one's true mathematical abilities (Ladson-Billings, 1995, 1999; Machado, 2017). In so doing, educators may perhaps adopt the eventual abolition of academic language in its entirety as a long-term goal of their pedagogy.

2. A middle stance towards mathematics instruction.

In an article for *Inside Higher Ed*, Catherine Savini (2021) describes a "middle stance" as an approach to instruction which seeks to position itself somewhere on a spectrum between the complete acceptance and rejection of Standard Language Ideologies in the classroom. This perspective "involves teaching students to communicate in [S]tandard [A]cademic English without degrading their dialect or home language by providing students with opportunities to use their dialects and languages in an academic setting and by exposing the power structures at work" (para. 7). Allowing and encouraging students to practice these comfortable language

forms not only presents no obstacle to learning (in actuality, it is more likely to make learning much easier and more personally resonant), it importantly transforms the mathematics classroom into an affirming and empowering space, where students are reminded to take pride in who they are, what they know, and how they speak.

Several of the multicultural strategies towards pedagogy explored in my discussion of theoretical and conceptual frames for this paper advocate for a similar position. The valorization of multilingualism and the orientation towards languages as flexible, complex, interactive codes that comes with heteroglossia (Blackledge & Creese, 2014), the simultaneous development of traditional and non-traditional linguistic codes in academic spaces embraced in a pedagogy of multiliteracies (New London Group, 1996), and the desire to support students' identity development and stimulate their motivation while educating them on the ability to effectively use empowered linguistic codes to their advantage that explicitly guide both culturally relevant and culturally sustaining approaches to pedagogy (Ladson-Billings, 1995; Machado, 2017) are each effective ways in their own right to engage with this premise, that can be easily adapted to respond to the particularities of a mathematics classroom.

3. A reevaluation of the methods of mathematics pedagogy and assessments of mathematical proficiency.

In her work on cultivating genius, Gholdy Muhammad (2020) notes that in educational spaces dedicated to the acquisition of literacy, teachers often default to an over-dependence on skills-based approaches to learning; in mathematics classrooms this often takes the shape of the rote practice and memorization of particular formulas, theories, proofs, terminology, techniques, the processes of determining solutions, and so on. While the ability to successfully and

accurately leverage these skills is critical to student success in the classroom, that the emphasis remains on particular, institutionally mandated skills erases or ignores the non-canonical ways of thinking, speaking and knowing that students bring to the table themselves and the historical role of literacy as a communal act of "self-empowerment, self-determination, and self-liberation [...] tied to action" (p. 22). In response to this observation, she proposes a four-layered framework of historically responsive literacy (HRL) which recognizes that literacy education must not only account for skill development (the pursuit of proficiency in content being learned for the sake of meaning-making), but also provide constant and integrated opportunity for the development of student identity (the ability to use literacy to make sense of who one is, and can be, in the world), intellect (the desire to constantly get smarter and gain new knowledge), and criticality (the ability to read texts to understand, or in the context of, power, privilege, and oppression).

Muhammad invites educators to recognize the limitations of traditional literacy curricula as exorbitantly self-centered and detached, and encourages them to reimagine their goals, their lesson plans, their pedagogical orientations and practices, and their curricula in the pursuit of developing students more readily prepared "to name and critique injustice to help them ultimately develop the agency to build a better world" (p. 12). In the spirit of her invitation, I also suggest that mathematics educators should commit to this process of reorientation.

One such location for potential redirection may come in the form of diversifying our mathematics curricula. It is not lost on many students that the vast majority of mathematicians named in the classroom are the quintessential "old, dead white men," and thus that they are unlikely to see themselves reflected in the mathematical canon. Finding opportunities to incorporate the mathematical innovations of Black and Brown, female or other non-male, and explicitly queer thinkers should be a priority within the classroom. But at the same time, a

recentering and teaching of mathematics' history, not simply its practice, should also be invited. A significant number of the mathematical theorems, postulates, and propositions which we take for granted are known to have originated in Africa and Southwest Asia (Folkerts et. al., 1999); including a historical framework for the study of these ideas makes this consideration transparent and immediate.

Another such location may come in disrupting the implicit belief in Freire's "banking" conception of education which is held to varying degrees by a number of mathematics educators. Drawing on traditional cultural imagery of banks as sites of deposit, this position structures relationships between teachers and students as sites exclusively for the transfer of capital, in the form of knowledge, from the educated professor to the uneducated pupil. This creates a clear power dynamic between educator and educated, where the former assumes a position of unquestionable authority, and often leads to the adoption of an inflexible pedagogy by the instructor at the head of the class. In the event of a potential miscommunication, the educator who ascribes to a banking model of education invariably places the blame on the student, and assumes their intellectual inability with little regard for the intricacies of the situation (Freire, 2018). The effectiveness of actively critiquing the power dynamics implicit in mathematical language fades if an educator continues to abide by this perspective. When miscommunication does arise, as it inevitably will, it is important to shift the sense of blame when applicable; the responsibility may lie on the mathematician for being inflexible and narrow-minded in their approach to and explanation of knowledge, rather than on the student for not comprehending the point being made (Chavez, 2021; Savini, 2021). Being willing to commit to flexibility and to take responsibility for one's limitations as an educator is integral to the sustained success of

students within the discipline and of a critical, situated approach to mathematical language and pedagogy.

Our pedagogy in the mathematics classroom also tends to be closely aligned with the goal of preparing students for standardized testing and other forms of impersonal assessment. As mathematics educators "teach to the test," if you will, expected to train their students to effectively navigate unnecessarily convoluted mathematical language or conceptualize mathematical exercises in the kinds of inaccessible and dehumanized ways that standardized testing prefers, it is natural to assume that the assessments we make use of in our own classrooms work towards similar ends. Our imagination can and should begin at the grassroots level — we might encourage mathematics teachers to tailor their assessments in order to assess student knowledge and comprehension rather than the ability to deploy their mathematical literacy in a particular way or reproduce the motions of their instructors; to provide students with opportunities to draft or revise their work, a more holistic and responsive alternative to the traditional model of one-and-done, in-class exams; and avoiding the pitfall of allowing one's perception of their students to be reduced to simply a number, a grade, or their performance on a particular exam.

Fundamentally, incorporated in their pedagogy, mathematics educators must seek opportunities wherever possible to muse actively on the power dynamics that are at play in the insistence on professionalism and mathematical language within the classroom, how history and power have played a role in its formation and canonization, and how its use upholds these same structures of power within society more broadly (Freire, 2018). And importantly, they must actively seek out ways to involve, and center, their students in such discussions, as co-creators of their educational experiences, wherever possible.

4. A review of the goals and priorities of mathematics teacher education programs.

Returning to Muhammad's analysis of the skills-obsessed state of literacy education, the same logic is often present in teacher education programs for aspiring mathematics educators. Overwhelmingly, mathematics teacher education programs in the United States have the tendency to focus disproportionately on content knowledge rather than pedagogical knowledge, leaving the majority of mathematics teachers under-equipped to actually teach the material in an effective or resonant manner (Lannin et. al., 2013). Mathematics teachers, in many ways a product of the tendency to view mathematics itself as a neutral and equally accessible discipline for all students, can reliably find a job and begin teaching without any explicit instruction on pedagogical best practice or with little to no awareness of, or reason to consider, the inequalities present in society that are reproduced within the institution.

Mathematics education programs must dispense with the primacy of content knowledge and instead strive to produce future generations of mathematics teachers that are not only capable and well-versed mathematicians, but who are socially conscious and culturally aware. Rather than simply teaching the way they were taught, mathematics teachers should be exposed to, and ask to develop proficiency with, a variety of pedagogical orientations to engage the linguistically and culturally diverse student bodies that they are often asked to serve. They should actively remind aspiring educators to adopt a growth-oriented, rather than a fixed, mindset of mathematical ability, being certain to challenge the presumption of biological determinism or the belief in the "math gene" that is disturbingly present in the public consciousness. They should see, as Muhammad suggests, identity, intellectual, and critical development not only as necessary components of their own pedagogy as it relates to their students, but as facets of their personal approach to and experience with mathematics as its active practitioners. The adoption of

Federico Ardila-Mantilla's (2017) four axioms of mathematical engagement referenced in previous sections, for example, serves as a potential starting point for this reframing.

5. A commitment to advocacy which extends beyond the immediate mathematics classroom.

Nelson Flores and Jonathan Rosa (2015) propose that "the ideological construction and value of standardized language practices are anchored in [...] *raciolinguistic ideologies* that conflate certain racialized bodies with linguistic deficiency unrelated to any objective linguistic practices" (p. 150). Rather than asking ourselves "what pedagogical innovations are possible if 'the goal of teaching and learning with youth of color was not ultimately to see how closely students could perform White middle-class norms but to explore, honor, extend, and problematize their heritage and community practices'" (p. 151), we instead abide, as suggested in the discussion of their article in the previous section of this paper, by the assumption that our engagement with particular linguistic codes should be mitigated by the notion of appropriateness, as it relates to the social contexts we find ourselves situated in. This premise, whether we realize it or not, leads us to continually mark non-academic linguistic practices of minoritized students with the language of difference; to position these "White middle-class norms" as eternally and exclusively appropriate, with the comfortable codes of marginalized students written off as constantly in need of supplementation. Embracing appropriateness-based discourse, even in an asset-based approach to education, also perpetuates the "false assumption that modifying the linguistic practices of racialized speaking subjects is key to eliminating racial hierarchies" (p. 155) by continually centering, and placing the onus of responsibility, on the "speaking subject" — the person who actively practices these linguistic codes — rather than the "listening subject"

(p. 152) who interprets them, and continues to racialize and stigmatize English speakers on the basis of their "linguistic markedness and deviancy" (p. 152).

"[R]aciolinguistic ideologies," the authors remind us, "produce racialized speaking subjects who [...] can be stigmatized regardless of the extent to which they approximate or correspond to standard forms" (p. 155). It is not enough to limit our advocacy to literacy practices within the classroom; simply adding an empowered code to one's existing lexicon is meaningless so long as the power lies, as it always does, in the listener rather that the speaker to control how or if their language will be interpreted, and again may unintentionally solidify the position of traditional mathematical literacy atop the food chain. Our solution, then, must necessarily include a commitment by mathematics educators "to engage with, confront, and ultimately dismantle the racialized hierarchy of U.S. society" (p. 167).

Addressing this issue only at the micro-level of the individual classroom, however, is a well-intentioned but ultimately incomplete response. Mathematics educators must not limit their advocacy to the spaces they themselves occupy and wield some degree of control over, but rather must be willing to call out the ways which we collectively perpetuate linguistic prejudice through adherence to particular standards of language use and assessment. One of the most immediately apparent cases of this is our society's dependence on standardized testing and academic tracking, which often subconsciously serves to reify narratives of racial, class, or gender superiority and inferiority.

Numerous studies have been conducted in decades past exposing the inherent bias in IQ tests and standardized exams such as the SAT, which were invented to reaffirm preexisting assumptions of racial hierarchy which favored whites and to justify eugenic practices. James Paul Gee (1990) offers that "often the members of a given social group make up tests germane to

the social practices of that group, pretend that these tests test mental 'skills' not tied to any given social practice, and then give them to members of other groups to 'prove' that they are underskilled, less intelligent, or 'illiterate'" (p. 59); Gloria Ladson-Billings (1999) also reminds us that assessment and intelligence testing often serve as means of legitimizing scientific assumptions of deficiency, emboldening and empowering white test-takers while subordinating and destroying the confidence of Black and Brown students. And yet, all too often, we continue to administer these tests under the guise of meritocracy and objectivity, sometimes because we feel powerless to imagine alternatives.

Similar outcomes are achieved in outsized dependence on sorting, tracking, and placement by way of prerequisite courses. Students invariably enter academic institutions at various points in their educational journey, but it is often the case that white male elites are the most likely to be placed in the most advanced courses as a product of their access to capital or the degree of relative privilege with respect to their education that they have been afforded. These elites, thinking the system is equitable because it served them well, that they have earned their spot by virtue of their own merit, are unable to see the blind spots in the opportunities that they have been afforded to function at higher levels, further contributing to the damages done in the feedback loop discussed above when these elites rise to greater positions of prestige within the discipline (Ardila-Mantilla, 2016).

We must encourage mathematicians to leverage the symbolic distinction that they yield in order to campaign for more equitable means of assessment nationwide, and to express their solidarity with institutions that are moving away from testing as a necessary prerequisite to a student's admission, as but one example of the types of advocacy which they may express their support for. Certainly, mathematicians should also find opportunities to participate in social

justice movements outside of these considerations alone, to which their work may only be tangentially connected, or to which those connections may not be immediately apparent at all.

6. The integration of ethics into the study of mathematics.

And yet, every single one of the above considerations fails before it has even begun if mathematicians are persistently unwilling to have discussions of ethics within mathematics. There is a long, well-documented history of reticence among members of the mathematical community to engage meaningfully with moral or ethical dilemmas raised in their work, one that remains today and is evidenced by modern mathematicians' continued appreciation for math's assumed intellectualism and abstraction (Chiodo & Bursill-Hall, 2018; Hardy, 1940; Koblitz, 1981; O'Neil, 2016; Shulman, 2002). Though they may not recognize it, as academics and as educators mathematicians have the ability, authority, and perhaps even the responsibility to intentionally investigate the standards and language on which the discipline relies as an ethical consideration, in addition to the various ways in which mathematics finds itself implicated in moral and ethical quandaries in the present day. Rather than falling into the trap of discussing language, much like the mathematics which it is used to discuss, as an entirely neutral endeavor, I believe that mathematicians have a responsibility to be aware of the statistical disadvantages it creates for, and the biases it encodes against, those from historically disenfranchised communities (Winner, 1980).

And even beyond this, I am confident that a move towards a more socially conscious and historically grounded understanding of the role of mathematicians will produce a more socially aware and accessible language as a consequence. Francis Su (2017), in a break with traditional conceptions of mathematics, proposes that the study of mathematics is necessarily undertaken in

the pursuit of "human flourishing;" that it cultivates hope, joy, community, perseverance, and rigorous thinking; that it engages the human desire for play, for imagination, for beauty, for truth-seeking, and even for justice. Mathematical language is to some extent both a system and a symptom; many of its problems parallel those of its parent discipline. I hope that as mathematicians become increasingly intentional in re-envisioning math as a discipline of communication, humanization, and community development (even if that development is purely intellectual or theoretical) rather than one for individual creative expression, that the language attached to it will evolve in the same direction.

Following the end of my differential equations course, I enrolled in Modern Algebra I, the final course that I would need to complete the mathematics component of my newly declared special major. Prepared for the worst, I was at least somewhat satisfied that this would be the last math course that I would have to stomach at Swarthmore. At the beginning of the semester, however, my schedule suddenly shifted; the problem session that I was required to attend as a part of my grade had been rescheduled such that it conflicted with another course that I was similarly obligated to take. After doing some sleuthing independently, I realized that there was a section of the course that was being offered at Bryn Mawr; it would be a tight squeeze, but with permission from the department chair, I signed up for the course and, as I had grown accustomed to, prepared myself for the worst.

You can imagine my surprise, then, when on the very first day, I left the classroom barely able to hold back a smile. For the first time in over two years, I was able to keep pace with the professor and make sense of all of the material that was covered, feeling challenged by what had been discussed without feeling like I had missed some crucial piece of information. Every

Tuesday and Thursday, I was almost excited to return to this professor, who for whatever reason was willing and able to make the content easily digestible, and the language that he used to communicate it readily accessible. Unexpectedly, I remembered what it felt like to be excited by mathematics, that feeling of unbridled accomplishment that came with coming to the right answer or analyzing the principles of a mathematical phenomenon that motivated me to want to become a mathematics teacher myself in the first place. Before I knew it, I had fallen back in love with math.

Fundamentally, when we discuss literacy and the associated contexts and frames that it is situated in, we're not just talking about language. We're talking about people, with unique sets of needs and desires and goals that motivate their practice and participation in academic spaces. It is these people that our pedagogy should seek to serve; these needs that we as educators should seek to meet; these desires and goals that we, in supporting them and meeting them where they are, should seek to help them attain. It is our obligation to meet them where they are, and to fight for and with them against the interlocking structures of oppression, reproduced at the level of the mathematics classroom, which detach them from their humanity and attempt to convince them at every turn that they are not, and never will be, good enough. Should we succeed in displacing and deconstructing these hierarchies, the possibilities, like the limits of mathematical thought, may truly be endless.

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