Living as Abstract Nonsense: Ontological Tensions in Trans Experiences of Mathematics

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Ontology—the recognition or erasure of ways of being—is a justice issue in mathematics, intersecting with race, gender, sexuality, and disability. Despite growing scholarship on liberatory ontologies in mathematics education, little is known about how such paradigms might be enacted in postsecondary contexts, or how trans mathematics-doers experience ontological tensions uniquely. We address this gap by analyzing a mathematical representation of trans experience created by a transfeminine, graduate student of color in mathematics, and the ontological tensions it draws from us as trans mathematician-researchers. Our findings identify ontological erasure, disembodiment, and categorization as features of mathematics that conflict with trans ways of being. We propose ontological possibilities for postsecondary mathematics that affirm trans and other marginalized realities, and invite further exploration of postsecondary mathematics as a site for ontological justice.

Keywords: ontology, trans mathematicians, gender, equity, embodiment

Ontological Justice in Mathematics Education: Literature Review and Research Aim

Settler colonial paradigms embrace dualist framings, such as mind/body, human/nature, and man/woman (Kovach, 2021). These dichotomies may perpetuate justice issues related to ontology (how ways of being are recognized or erased). For example, settler colonial dichotomies related to sex and gender have historically framed Indigenous diversity in sexuality and gender as primitive (e.g., Morgensen, 2010) and been used to punish Black people through violations of their gendered and sexual self-definition (e.g., hooks, 1981).

Settler ontologies underpin dominant views of math, reinforcing marginalization by race, gender, sexuality, and disability (Butler, 2024; Gutiérrez, 2017; Martino & Cumming- Potvin, 2018; Westby, 2021). For example, math is framed as an intellectual pursuit, which is valorized in the hierarchical dichotomy of mind and body. Societal portrayals of Black people as primal and hypersexual rather than intellectual (McNeill & Jefferson, 2024; Strings, 2020) enact the mind/body and human/nature dichotomies, shaping dehumanizing conditions in math education, the educational outcomes of which perpetuate Black dehumanization. (McNeill & Jefferson, 2024; Joseph et al., 2019). Cultural ways of being can also be marginalized through engagement with math content. For example, since math is often construed as intellectual, its teaching can sideline physical and spiritual presence that is vital to Indigenous ways of knowing (Gutiérrez, 2017). Similarly, binary parities in math can naturalize cisheterosexuality to alienate queer students whose being is implicitly construed as mathematically illogical (Leyva et al, 2022).

A growing body of research theorizes diverse ontological possibilities in mathematics (e.g., de Freitas & Sinclair, 2013; Gutiérrez, 2017, 2022). For example, seeking to honor materiality and embodied knowledge in school mathematics, de Freitas and Sinclair propose teaching the number line as an elastic line that can be grabbed and stretched "so that it brings forth an infinitude of numbers that were imperceptible a moment earlier" (p. 465-466). At the postsecondary level, emerging scholarship in mathematics (e.g., Ardila-Mantilla, 2016; Paton,

2025; Cheng, 2025) integrates mathematical and relational ways of being and knowing to advance equity. For instance, Paton challenges both the mathematical and social value of equality, framing category theory as a paradigm for equivalence that embodies equity. These emerging disruptions of dominant mathematical ontologies reflect a demand for liberatory ontological possibilities in postsecondary mathematics education research.

Ontological tensions can be particularly salient for trans[1] people, as we navigate gendered societal assumptions and expectations that are often incongruous with our internal realities. However, research knowledge about trans ontologies in mathematics is limited. Two studies of trans experiences in mathematics exhibit ontological themes, but report on social dimensions of undergraduate contexts (e.g., gendered assumptions of mathematics ability, positive experiences in collaborative learning environments; Cassiday, 2019; Kersey & Voigt, 2021). For example, Kersey and Voigt asked students to create graphs of their trans mathematics experiences with axes representing masculinity/femininity and cisgender non/conformity. However, they did not examine how students' trans being shaped their engagement in the mathematical task.

Ontological tensions can be a generative and powerful informant for liberatory ontological possibilities in mathematics education and beyond (Anzaldúa, 2002; Gutiérrez, 2012, 2016; Myers et al. 2023). Towards theorizing ontological possibilities, we draw from a study of trans mathematicians' experiences, centering AT, a transfeminine graduate student of color. We analyze a mathematical representation of her intersectional experiences as a trans mathematician, queering the researcher–participant boundary by examining resonances with our own ontological experiences (Heckert, 2016; Nash, 2016; Rooke, 2016) as trans mathematicians. We pursue the research question: How does AT's representation illuminate, and invite us to collectively inhabit, generative ontological tensions between mathematics and transness?

Theoretical Perspectives

We ground our work in gender theory (Butler, 2011), queer theory (e.g., Muñoz, 1999) and new materialist ontologies (deFreitas & Sinclair, 2013). Queer theory critiques and destabilizes sex and gender binaries in culture, society, and politics to "offer alternative ways of thinking and performing in the world" (Voigt, 2022, p. 4). However, alternative, liberatory ways of performing gender are not free from embodied and political realities. Addressing common misinterpretations of "gender performance" (Butler, 2002) as independent from corporality, Butler (2011) prompts us to consider how the sexed body is socially constructed. Bodies "only appear, only endure, only live within the productive constraints of certain highly gendered schemas" (Butler, 2011, p. x) and become intelligible only under certain conditions. The act of imposing intelligibility to the body as either male/man or female/woman creates a category of being which is unintelligible by dominant society, fueling (trans) oppression through limited social and political recognition (Butler, 2011; The White House, 2025). This societal exclusion from intelligibility defines "foreclosures and repressions that constitute the discontinuity and incompletion of the [trans] subject" (Butler, 2011, p. 141), framing some bodies as "unthinkable, abject, unlivable bodies" (p. x). Relationality between the body and society also extends past gender: its interconnections with race, in particular, structure which bodies (often white ones) are rendered legible in their rejection of cisnormativity, and which (often non-white bodies) might *disidentify* with a politicization of gender that presumes whiteness as normative (Muñoz, 1999). We leverage these ideas of gendered, raced, bodily intelligibility to consider how trans ontology may resist governance by political-mathematical cisgender binaries, especially as experienced by

[1] We use *trans*, abbreviated from transgender, to reflect language used within trans communities.

AT, a trans mathematician of color. Drawing from Muñoz's (1999) disidentification as "productive interventions in which politics are destabilized" (p. 102), we name this ontology as a gendered experience in a perpetual state of flux between (dis)embodiment and (dis)identification.

We engage new materialism to deepen our exploration of mathematics as a dis/embodied, dis/identified gendered experience. New materialism frames matter and agency as intertwined and cocreated (deFrietas & Sinclair, 2013). Providing both non-human and human examples, deFrietas and Sinclair contend that the uncertainty principle in quantum physics demonstrates that "indeterminacy is intrinsic to matter" (p. 460) and similarly "the [human] body is…[not] passive matter upon which culture is inscribed... it is centrally implicated in the constitution of itself and society" (p. 460). So too is matter's relationship to mathematics. The body can be viewed as "an assemblage of human and non-human mathematical concepts" (p. 453) that, in turn, resonates with and extends mathematical ideas. Recognizing how the body both creates and is constituted from mathematics provides a bridge between queer theory, mathematics, and ontology, creating mathematics and trans being as together fluid, ambiguous, and queer.

Methods

In alignment with the study's aim of legitimizing trans ways of knowing and being in mathematics education, our inquiry drew from queer and embodied methodological paradigms.

Context, Researchers, and Participants

This analysis comes from a larger study of trans mathematicians' experiences, inclusive of those who completed at least one year of a U.S.-based doctoral program in the mathematical sciences. In early 2025, we recruited participants through professional mathematics organizations that centered marginalized identities (e.g., Spectra, Lathisms, Sines of Disability). We selected 20 participants, prioritizing those with multiple marginalized identities. Our research team consists of five white trans people (two faculty, two doctoral students, and an undergraduate).

We selected our focal participant, AT (she/they/it), because their mathematical representation was uniquely evocative in its interplay between mathematical and trans ways of being. AT is a transfeminine graduate student of color who holds additional marginalized identities. AT was consulted about identifiability risks, and a draft was shared for her review.

While data were collected by the full team, analysis and writing were completed primarily by the first three authors. These authors identify as mathematicians, spanning graduate to faculty experience in mathematics. Queer methods embrace researcher subjectivity and blur boundaries between researchers and participants, establishing credibility through reflexivity (Heckert, 2016; Nash, 2016; Rooke, 2016). We leveraged our lived experiences as mathematicians to occupy this researcher-participant boundary. McNeill (they/them) is a femme trans man with a history of mental illness and disability. Davis (they/them) is a neurodivergent, nonbinary transmasculine graduate student. Black (she/they) is a queer, transfeminine, neurodivergent, able-bodied graduate student. The team acknowledges racial power dynamics inherent in white scholars drawing analytic conclusions from narratives shared by a participant of color. Informed by analytic autoethnographic methods (Anderson, 2006), we make our positionalities transparent throughout the study to acknowledge our subjective influence on the knowledge it produces.

Data Collection

Participant Data Collection. We conducted, recorded, and transcribed two 90-minute interviews over Zoom. The first interview explored participants' trans and mathematics histories. Afterwards, participants engaged in an open-ended, reflective exercise—to create a mathematical

representation of their intersectional experiences as trans mathematicians. The second interview asked participants to narrate their representation, and probed further into connections between mathematics, transness, and intersecting identities. We present AT's representation in Figure 1.

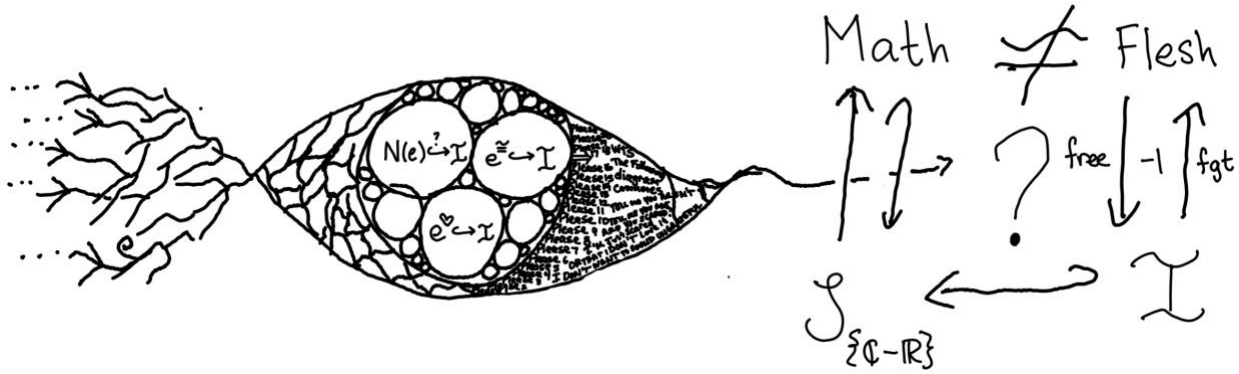

Figure 1. AT's mathematical representation of their intersectional experiences as a trans mathematician. AT's handwriting has been replaced by McNeill's to retain authenticity while protecting AT's anonymity.

We briefly explain AT's representation to contextualize later findings. The right side is a (potentially) commutative diagram. AT uses *I* to represent the self and conceptualizes the self as flesh with extra structure. There is a "free" map that includes the flesh into the self, and the forgetful functor maps the self to the flesh. The self is mapped injectively into an imaginary (the complex numbers without the real line) realm. Math is also included in the imaginary. On the left side is an eye, whose iris contains circle packings. The large circles pose possible injections of semi-mathematical objects (e.g., $e^{\heartsuit}$) into the self. Lines branching from the eye on the left represent both nerves and eyeliner. The right side of the eye contains the words "WTS [wish to show] The Following diagram commutes. TELL ME YOU AREN'T. ARE YOU FLESH? TELL ME YOU ARE. ARE YOU SCARED? I'M Just Scared. OR THAT I DON'T Love it. I DIDN'T WANT TO SOUND UNGRATEFUL" (capitalization in original). The right side of the iris is lined by 20 numbered instances of "Please."

Researcher Data Collection/Analytic Note-Taking. The last stage of data collection and first stage of analysis consisted of (embodied) analytic note-taking. The first three authors each read AT's transcripts alongside its representation. In alignment with our research question about ontological tensions we collectively inhabit, we each recorded our embodied experiences of engaging with AT's data (e.g., emotions, physical sensations), and the personal experiences and stories to which these embodied responses were attached, through in-line analytic note-taking. We intentionally brought awareness to our racial experiences and observations to mitigate race-evasive interpretations of AT's experiences. As empirical inquiry (Richardson, 1994; Richardson & St. Pierre, 2005), this writing externalized our thinking, fostering "adventure and experimentation" and bringing forward 'the unintelligible' (St. Pierre, 2018, p. 605) that conventional forms of data analysis often miss. We combined our notes into one document, AT's transcript augmented with researchers' reflections placed in their original locations. We color-coded each person's contributions to preserve the distinctness of our perspectives.

Data Analysis

Guided by queer and embodied methodologies' attention to researcher subjectivity, we conducted a reflective thematic analysis (Braun et al., 2023). To address the research question about how AT's narratives illuminate, and invite us to collectively inhabit, ontological tensions

between mathematics and transness, we first coded the augmented transcript for connections to ontology. We then identified collective thematic tensions. Guided by our positionality, we selected themes that were salient in AT's narrative rather than those driven mainly by researchers' reflections, preserving the intersectional complexity of AT's ontological tensions even when intersectional dimensions were not mirrored in the researchers' realities.

Findings

Analysis revealed three collective ontological tensions between mathematics and transness: mathematics is construed as real while trans people are construed as imaginary, mathematics is positioned as disembodied while trans people are made especially aware of their bodies, and mathematics is categorical in nature while trans self-understandings are often anti-categorical.

Imaginariness: "Weird Nonsense that has Implications… with a Capital 'I'"

AT's maps of the self and mathematics into non-real, complex numbers suggests a parity between the imaginariness of her being and mathematical truth. However, she witnessed a social validation of mathematics as real that she did not experience in relation to their own existence. Its sense of "not being real…, being imaginary, just that sense of unreality or being invisible" was sustained by the marginalization it experienced as a woman, trans person, and religious minority in a largely cisgender, male, secular field. They described frequently being "talked over" or having their bodily needs neglected through professional mathematics structures (e.g., conferences where they could not safely use the restroom, speaker dinners during religious observances). Interactions reinforcing this ontological erasure were largely unintelligible through a dominant mathematical lens, which failed to connect such experiences to AT's identities: "you can't repeat the social interaction in a double-blind exam or anything." Our resonances with AT's invisibility communicated implicit pressures to legitimize transness in math, questioning "What aspects of [my gender presentation] do I need to erase" (Davis) and noting that the lack of recognition for non-binary identities "positions me as non-real on both sides" (McNeill).

This gendered invisibility contrasts the invisibility of mathematics. AT recognized much of mathematics as "abstract nonsense" that was widely legitimized. Black noted, "to be not real in a mathematical sense carries a sort of intriguing depth,... vision, and excitement; meanwhile, to feel not real as a person… carries a mournful and sad heaviness,... disassociation or… disconnection." This represented a double standard, as McNeill commented:

> A lot [of] mathematics… prov[es] the existence of… things [that] are… not tangible… Things that are tangible, like the body, paradoxically, do not really exist in mathematics. The supposed objectivity of mathematics renders the subjectivity of the body invisible.

This double standard materialized through experiences of misogyny. AT described a traditional view that "mathematicians are discovering secrets of the universe," which evokes a sense that "math [i]s this higher power or perfect form of knowledge and logic" (Davis). AT characterized mathematicians holding this view as "super misogynistic… they're like, 'Yes, I'm better than you.'" This power imbalance renders mathematics as real and trans existence as imaginary. Yet, she described the field as "moving away" from this view: "the gays" in mathematics often said, "look at this weird little thing I have made… Can I show you my arrows?"—a framing that presents mathematics as a human endeavor and may open more ontological possibility.

(Dis)embodiment: "Does Everyone… Think about Flesh… as Much as… a Trans Person?"

AT's ontological tensions with the disembodied framing of mathematics stemmed from the interplay of three factors: her need for positive connection to her racialized, transfeminine body,

the abstract nature of her subfield, and her recognition that mathematical language often borrows flesh-related terms. Category theory uses many flesh-related words, which tempted her to force a mathematical understanding of her own body, as evidenced in AT's mathematization of their embodiment, considering the self as "flesh with extra structure in a monoidal category".

AT's reconciliation of (dis)embodiment in mathematics was both playful and poignant. For example, in their representation they denoted the "heart of a category" with the symbol ♡. They also described playing a game with non-category-theorists: "Is this a math word or am I bullshitting you?" using "body-related things" like "hearts", "skeletons", "cores", and "nerves." Black felt especially "tickled" to learn of category theory's "Theorem of the Heart". Despite these linguistic connections, AT's embodied experience remained mathematically unintelligible. Considering the heart of a category, she questioned, "[Are] these structures inside of me?" and lamented how "math isn't helping [her]… in terms of understanding [her] relationship to the flesh." Resonating with AT's sentiments, the authors noted that "I can touch a knitted sweater in a way that I can't touch my math homework" (Davis), which contributed to ontological disconnection as mathematicians who "experience the body only through metaphor" (McNeill).

AT's sentiments illuminate liberatory ontological possibilities of welcoming the body's subjectivity in mathematics. AT perceived that mathematicians' appeal to the body is neither a coincidence nor an accident. For example, they argued that ♡ is "much more indicative" of the essence of the heart of a category than the "abstract instructions" of the formal definition ("...the truncation above by zero and the truncation below by zero…"). Furthermore, AT noted that "people in math… lov[e] going on hikes and rock climbing… they're also connecting to their bodies even if they're cis[gender]," which she conjectured might represent a universal need among mathematicians to be more connected to their physicality. Moreover, McNeill noted that embodied subjectivity is inherent to mathematical thought: "I think with a piece of meat. We all do. How objective can meat be?" We collectively considered the political possibilities of recognizing such subjectivity. For example, AT noted that mathematics is "heavily funded by the NSA," an organization that placed their community under heightened surveillance. A more embodied mathematics might resist such forms of dehumanization.

Categorical (Un)Intelligibility: "This Doesn't Make Any God Damn Sense"

AT's visual references to math, flesh, and mathematical "unreality" illustrate its desire to categorize its world, identity, and mathematical experiences in logical ways. By representing itself in a commutative diagram, its intersectional trans experiences are described through sources and targets. This presents an ontological tension between what can be categorized and her intersectional trans experiences which defy logical structure and categorization.

For example, while discussing the non-equivalent relationship between mathematics and the flesh represented in her commutative diagram, AT explained "math is not flesh, it is sort of different… [I'm] trying to think about how I'm structuring my life." AT's attempt to "structure" her life category theoretically led to her questioning whether her diagram (and therefore herself) "commute up to a higher homotopy." Such sentiments represent AT's impulse to mathematize and categorize her body, self, and mind, which were shared by the authors. For example, Davis described a desire for gendered coherence, expressing frustration at not being categorized correctly in social interactions. They noted that their androgyny "doesn't read for people," which led them to wonder, "what cues am I missing?" In our trans experiences changing names, appearance, or pronouns also reflected the pursuit of intelligibility by cisgender society.

AT's attempts to categorize their existence, however, were in tension with the fluidity they embodied as a creative and gender-transgressive person. Later in the interview, she abandoned attempts to categorize herself, explaining that the difficulties of trying to represent herself mathematically resolved when she chose to treat the commutative diagram as poetry and to "not [be] super worried about the math." However, she recognized this approach opposed accepted approaches to mathematics: "if an actual category theorist saw this, they'd be like, what the fuck have you written?" AT's playfulness and creativity with conventional categorization was also reflected in her nonbinary gender expression where "ambiguity is some part of the point for me." For example, she described dressing in a more feminine way in mathematics contexts where "girliness is not allowed." Similarly, when discussing her pronouns, she described picking different pronouns to use on different days, or inviting fellow trans people to use he/him/his pronouns to refer to her exclusively when "it's funny", saying "If I'm wearing a ball gown, that's a 'he.'" The authors shared AT's desire for incoherency. McNeill expressed a desire to "live apart from the cisgender world," a nod to unintelligibility as freedom from dominant binary categorization (in mathematics). AT's abandonment of the rigor of her commutative diagram, thus, represents our collective search for mathematical freedom and unintelligibility as a tool for self-expression. Overall, AT's attempt to describe itself through the systems of category theory illuminates ontological tensions between its embrace of life as an unintelligible system and its desire for a life that can be described systematically through their field of mathematics.

AT's desires to use mathematics in ways that defied standard mathematical coherency illuminate ontological possibilities for trans affirmation. McNeill noted that "there is something delightfully metaphorical about questioning the existence or coherence of the self in relation to mathematics at higher dimensions" and compared this to aspects of physiology, such as the placebo effect, that "escape understanding." Black also highlighted how, as trans people and mathematicians, there is a "persistent push to interrogate and challenge and wonder about whether or not our existing models of the world are working for us." When existing models fail, we, as mathematicians and trans people, ask "what perceived limitations or assumptions do we have that we need to forget?" These desires explore the possibility of unintelligibility as a mathematical value, resolving ontological tensions between conceptualizations of mathematics as structure and trans realities that often revel in nonconformity and unintelligibility.

Discussion & Conclusion

AT's representation offers a pathway toward trans ontological justice in mathematics, extending theories of liberatory ontologies to reveal new possibilities in postsecondary contexts. Scholarship on ontological justice in mathematics education often seeks to disrupt settler colonial paradigms by contextualizing mathematical ideas within ecological and social imperatives (e.g., Gutiérrez, 2017). Yet, abstract mathematics, such as category theory, defies contextualization. AT's representation offers new directions for disrupting settler colonial, binary paradigms, reminding us that the materiality of the body—and the political contestations that shape its social signification—are ever present in mathematical inquiry. By recognizing "pure" mathematics as a social construction, AT positions mathematics as a flexible human creation whose ways of knowing and being can expand through embodied and social experience, revealing situated and partial truths; mathematics need not be an absolute truth to which our humanities must yield. AT's experiences also highlight that transness marks avenues for *dis*identification from settler knowledge production, illustrating ways of doing and teaching mathematics with decolonial intent. We call on mathematicians and researchers to explore how attending to students' ontological affirmation in mathematics can generate new and diverse educational possibilities.

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