



Emily Riehl

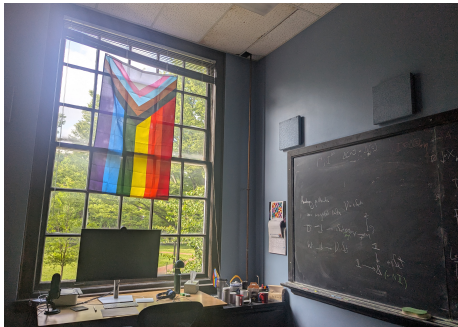
Johns Hopkins University

Queer in math and queering math



Hardy Lecture Series, Edinburgh

Queer in math





Queer theory challenges essentialist or normative conceptions of identity, often using personal stories to show the limits of conventional categories.

In this talk, I will share my journey as a queer mathematician, tracing the formation of a pair of identities that were more often developed in parallel rather than fully integrated.

I will also describe a recent “queering” of the concept of “identity” in mathematics, which enables a more expansive notion of mathematical equality than appears in traditional mathematical foundations.

Plan



1. Queer in math

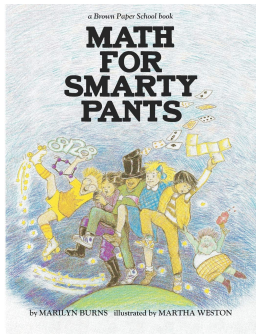
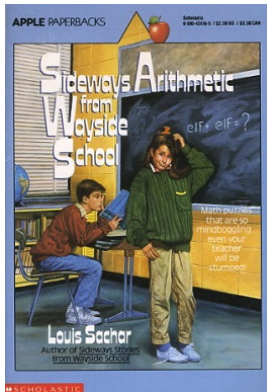
2. Queering math



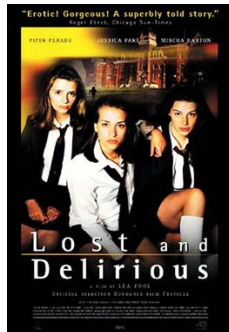
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Queer in math

Queer math childhood



Queer in math in high school



On the intersections of polynomials and the Cayley–Bacharach theorem

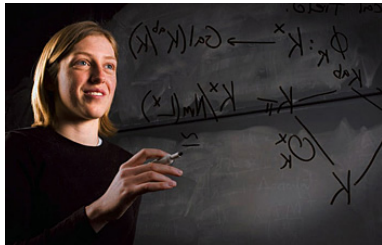
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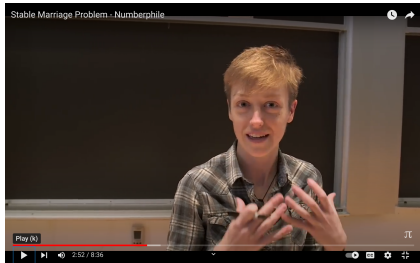
Queer in math in college



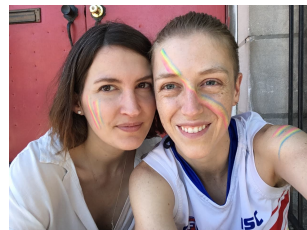
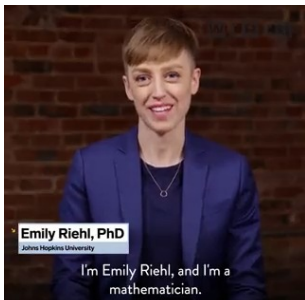
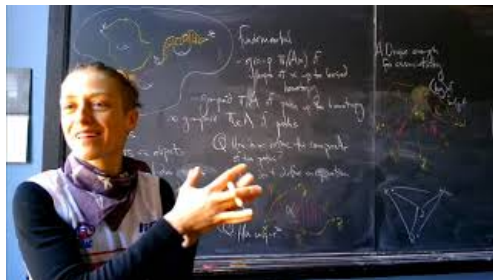
Queer in math grad school



Queer as a math postdoc



Queer as math faculty



On performing queerness in mathematics



In 2017, I interviewed Mike Hill for the American Mathematical Society's [inclusion/exclusion](#) blog.

ER: As you were developing a queer self-identity, was there any intersection between that and your mathematical identity?

MH: No. It was one thing that was always a bit of an internal disconnect for me. When I was growing up the images that you would see of queer people were always like, what I think of now, as almost minstrel scenes. Like Jack in "Will and Grace." These are the role models that you'd have: things like fashion, dance, art. A lot of my concept of "Gay" came through things like literature. There isn't a whole lot of literature written about gay mathematicians or even someone in STEM. There are no movies like this.

ER: Well there's the Turing film now.

MH: It doesn't really end well for him.

On performing queerness in mathematics



MH: It was so much so that when I was a first year in college I had trouble reconciling how to handle the fact that I was super interested in things like queer and feminist theory and also I knew I wanted to be a mathematician and I didn't know how to bide my time. All my friends in the queer community were taking all these gay and lesbian studies classes but I didn't really have time for that because I was taking an awful lot of math courses. I was wondering, should I try to do a dual major? Is this how one performs gay?

ER: Did this affect your experience in a mathematics classroom? Or were you focused on the math and not really embodied in that headspace?

MH: There's no external marking in queer identity: it's all performative marking. I never knew if any of the faculty who were teaching classes were LGBT. I never really knew about any of the other students. There was no space where that was really discussed. You talked about the theorems and you talked about confusions about the theorems. There was actually never discussions of personal life.

On performing queerness in mathematics



ER: Returning to something you said previously about queer identity being something that's not necessarily visible but that is performed, I remember very clearly when I first met you. It was at the Fields Institute in 2010. I was still in grad school. What I remember was that you were the first person I had seen performing queerness in a mathematics research context. You were dressed more or less like you are today.

MH: I'm wearing a t-shirt and jeans.

ER: Sure. Right. [laughter] You've described yourself as snarky. It was your affect, your way of speaking, and I thought it was the coolest thing I had ever seen, because it was something I had never seen before.

MH: Thank you.

ER: It struck me as so you. You were enlarging the space of what is possible in the performance that is the mathematics lecture. So, how did that happen?

On performing queerness in mathematics



MH: I guess like all things organically. Part of it is that I got less and less good at turning it off, at code switching between camping it up with friends vs giving lecture. When I first started teaching, I would try to be conscientious about using less inflected speech, having fewer wild shifts in intonation and less obvious queer markings in discourse. But then I just started to not worry as much.

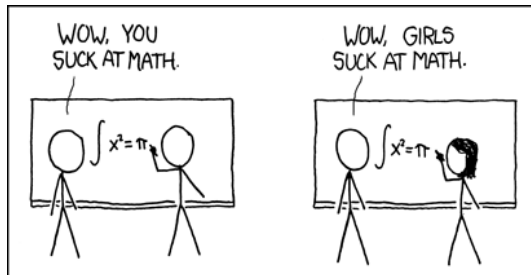
By the point of Fields Institute 2010, I had my job at Virginia. I actually had tenure at Virginia. And I felt like I could deliberately choose to completely stop trying to worry. Thinking back to when I was a student, I didn't know a lot of queer mathematicians. Now I know many many queer mathematicians, many whom will say "I was never in." Okay. But it's not the kind of thing I knew starting out.

I wanted to start to push that envelope and force mathematicians who claim to be very liberal and progressive — and by and large are extremely liberal and progressive — to recognize that not everyone does math the same way. I think that translates into a lot of things. Not everyone performs math as the white cis het male. There are lots of other things.

Supporting queer students in math



Some students in a mathematics classroom may feel alienated from their peers for reasons that may or may not be visible.



- Can you help make everyone feel more comfortable speaking up?
- Can you foster community and collaboration, beyond existing friend groups?

Supporting queer students in math



Some students in a mathematics classroom may be reconsidering some aspect of their personal identity, or may not be fully out.

- Offer students a private way to introduce themselves to you, and if appropriate, ask how a student would like to be referred to in various settings (in class, in office hours, in letters of recommendation).
- Learn and use students' preferred names and pronouns.
- Find out about the resources for queer students offered by university, which may offer awareness training for faculty members.

Supporting queer students in math



Some mathematics students may face specific challenges when navigating the profession.

- Advocate for gender-neutral restrooms in convenient locations.
- Ask in advance about roommate assignments at conferences.
- Advocate for policies that make it easy for mathematicians to change the name they use in professional settings.

Supporting queer students in math



Some mathematics students may be particularly distressed by current events.

- Build community in your department to help everyone feel more connected.
- Join the Outlist or Ally List hosted by <https://lgbtmath.org/> or form and support a student chapter.





2

Queering math

The traditional view of equality



Reflexivity:
anything is equal to itself.

$$\forall x, x = x$$

Indiscernibility of Identicals:
if two things are equal, then they have exactly the same properties.

$$\forall x, y, (x = y) \rightarrow (\forall P, P(x) \leftrightarrow P(y))$$

Indiscernibility of identicals in action



For example 137438953440 factors as

$$137438953440 = 2^5 \times 3 \times 5 \times 17 \times 257 \times 65537$$

Here

$$3 = 2^{2^0} + 1, 5 = 2^{2^1} + 1, 17 = 2^{2^2} + 1, 257 = 2^{2^3} + 1, \text{ and } 65537 = 2^{2^4} + 1$$

are Fermat primes.

Thus the regular $2^5 \times 3 \times 5 \times 17 \times 257 \times 65537$ -gon can be constructed by straightedge and compass.

By the indiscernibility of identicals the same is true of the regular 137438953440-gon.



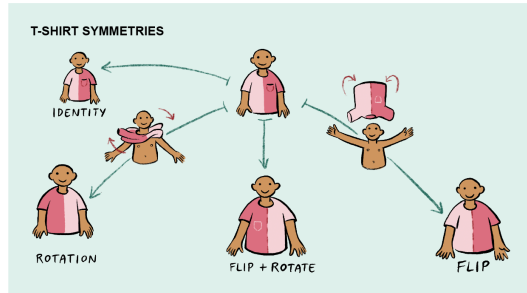
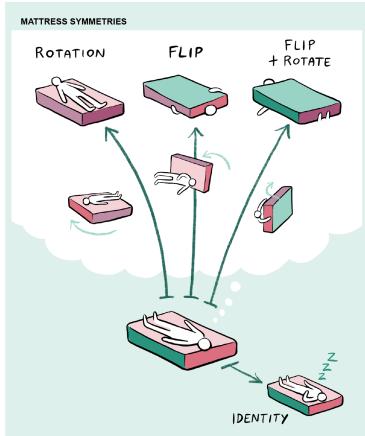
...la Mathématique est l'art de donner le même nom à
des choses différentes.

...mathematics is the art of giving the same name
to different things.



— Henri Poincaré
“L'avenir des mathématiques”
Science et Méthode
Flammarion, Paris, 1908.

Different things that deserve the same name



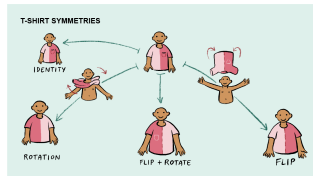
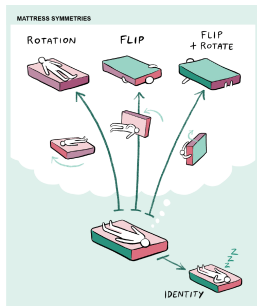
images by Matteo Farinella

In traditional foundations, the collections of **Mattress Symmetries** and **T-Shirt Symmetries** are NOT equal, as they don't have the same elements. Indeed, indiscernibility of identicals fails regarding the set-theoretic properties of these groups.

The moral indiscernibility witnessed by an isomorphism



Instead, the group of **Mattress Symmetries** and the group of **T-Shirt Symmetries** are **isomorphic** — **Mattress Symmetries** \cong **T-Shirt Symmetries** — meaning that they have the “same shape” as symmetry groups.



images by Matteo Farinella

There is a “moral” sense in which the isomorphism **Mattress Symmetries** \cong **T-Shirt Symmetries** implies that these symmetries are indiscernible as groups, rather than as sets.

Queering equality



In a non-traditional foundation, an isomorphism of groups becomes an equality

$$\text{Mattress Symmetries} = \text{T-Shirt Symmetries}$$

or more precisely

$$\mu : \text{Mattress Symmetries} = \text{T-Shirt Symmetries}$$

where μ matches up the respective identities, rotations, flips, and flip-rotations.

Theorem (structure identity principle). Via

$$\mu : \text{Mattress Symmetries} = \text{T-Shirt Symmetries}$$

these groups have exactly the same group-theoretic properties.

A non-practical application



Theorem (structure identity principle). Via

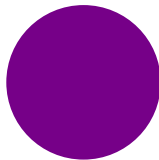
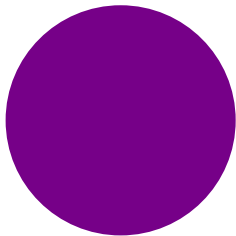
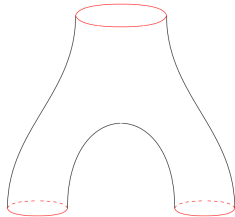
$$\mu : \text{Mattress Symmetries} = \text{T-Shirt Symmetries}$$

these groups have exactly the same group-theoretic properties.

Based on personal experience, you may have discovered that the group of **Mattress Symmetries** has no **generator**: there is no single move that you can repeat each season that will cycle through all possible configurations of the mattress over time.

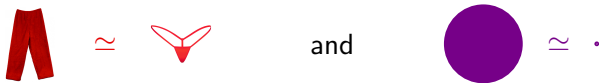
Via the equality $\mu : \text{Mattress Symmetries} = \text{T-Shirt Symmetries}$ the same is true of the group of **T-Shirt Symmetries** — which is bad news if you're trying to get away with wearing the same shirt day after day after day.

Different things that deserve the same name







Equivalence = equal + worth

As spaces, the pair of pants and thong are **NOT isomorphic**. Similarly, the solid disk is **NOT isomorphic** to a point. However, they are **equivalent**:



Extending the queering of equality up to a higher dimension, there is a sense in which



Theorem (structure identity principle). Via μ :  =  and τ :  = .

these spaces have exactly the same homotopy-theoretic properties.

Formally queering equality



In **type theory** mathematical sentences take the form of **types** A , B , C .
An **element** $x : A$ in a type then provides a **proof** of the encoded statement.

Identity types are governed by the following rules:

- For any type A and terms $x, y : A$, there is a type $x =_A y$.
- For any type A and term $x : A$, there is a term $\text{refl}_x : x =_A x$.
- For any type $P(x, y, p)$ defined using terms $x, y : A$ and $p : x =_A y$,
 - if there is a term $d(x) : P(x, x, \text{refl}_x)$ for all $x : A$,
 - then there is a term $J_d(x, y, p) : P(x, y, p)$ for all $x, y : A$, $p : x =_A y$.

No nonsense: it's only meaningful to identify things in a common type.

Reflexivity: anything is identifiable with itself.

Indiscernibility of Identicals: if two things are equal,
then they have exactly the same properties.

Univalence and its consequences



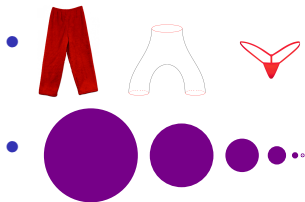
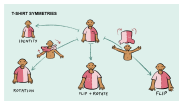
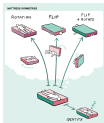
The **univalence axiom** relates the identity types in the **universe of all types** \mathcal{U} to **equivalences** between types.

“Identity is equivalent to equivalence.”

$$\text{univalence} : (A =_{\mathcal{U}} B) \simeq (A \simeq_{\mathcal{U}} B)$$

The things that deserve the same name:

- 137438953440 and $2^5 \times 3 \times 5 \times 17 \times 257 \times 65537$



are **terms** belonging to a common **type**.

As a consequence of the **univalence axiom**: **identifications** — that is, witnesses to **equality** — recover mathematicians' intuitive notions of sameness.



Thank you!